Journal of

The Trail Boss ®

American Society of Range Management

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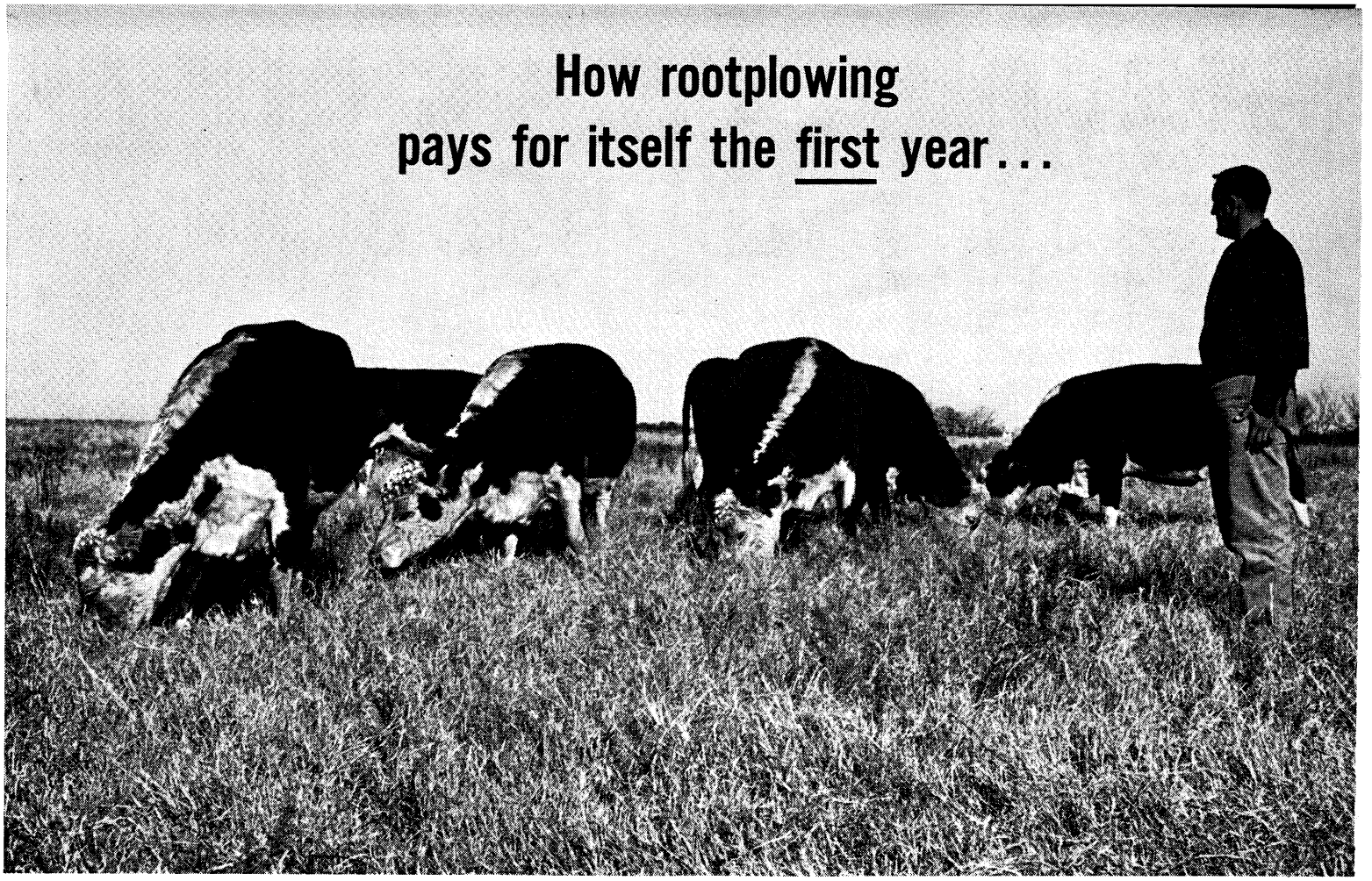
Cover Photo—Lands for Integrated Management

Photo by Dillard H. Gates, see story under Management Notes, page 274

How rootplowing pays for itself the first year...



and will continue to build profits for Loyd Burchfield year after year

Not long ago, this land near Mansfield, Texas, was mesquite-covered and virtually worthless, requiring 15 acres to run one head. Attempts at chemical control failed.

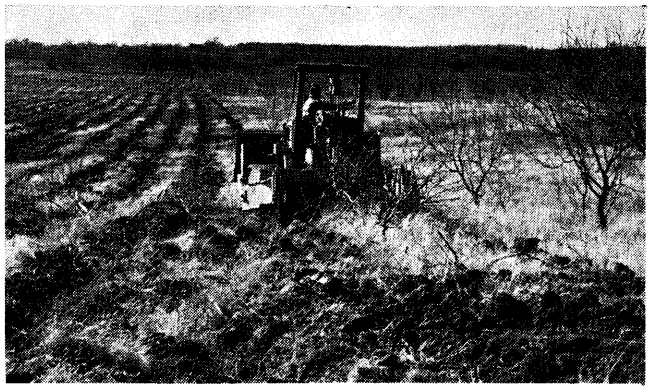
Then in the winter of 1960, owner Loyd Burchfield had about 50 acres of dry, hillside land rootplowed to bud-ring depth and seeded with Coastal Bermuda grass. Rootplowing not only resulted in a 99% mesquite kill, but it also improved aeration and water-holding characteristics of the soil.

By the following August, the grass had made an excellent start, and Burchfield put out 20 heifers. Each cost $135. After grazing all winter and dropping calves, they were sold for $225 a pair.

"I made enough money the first season," reports Burchfield, "to pay for establishing the pasture."

The second year Burchfield had 45 cows and calves on the pasture all year. Fifteen more steers on the revived land gained better than two pounds per day for 150 days. Later he ran an additional 15 steers on the land. "Still," he reports, "there was more hay on the ground than they could eat all year." Thus, Burchfield not only got an immediate return on rootplowing, but he has made an investment that will continue to pay for years to come.

Your Caterpillar Dealer can show you equipment to solve similar problems for you. Or he will recommend contractors with equipment to do the job.



Rootplowing on Burchfield Ranch. Photos Courtesy of Dalworth, Texas, Soil Conservation District.

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Trends in Range Management Education

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Highlight

This survey indicates that total enrollment and demand for range graduates are increasing. Fewer students are looking to the government for employment as more jobs in private industry become available. If the current trend continues, there should be plenty of students from range schools to fill range jobs. The range profession must act to see that all students who call themselves range men have training acceptable to the profession.

Range management is one of the fastest growing areas of biological science. Rangelands cover some 700 million acres in the United States, and the range management profession is called upon to furnish trained personnel to increase production on these lands.

During the past few years, there was a severe shortage of men with range management degrees. Frequently employers were forced to hire poorly trained men or men trained in fields other than range management. Holscher, et al. (1963) predict that the demand for college trained range men will increase throughout the 1960's. A recent report to the Society of Range Management at Wichita, Kansas, indicated that the Federal government alone hired some 100 range graduates a year. Even with the cutback in Federal employment, there is still a constant demand for range management graduates.

The Range Management Education Council appointed a committee in February 1964 to compile statistics on the availability of range management students and the trends in the supply of range management personnel from the various schools. This paper reports the findings of that survey.[1] It is presented to the profession in order to bring about a better understanding of the problems in range education.

Questionnaires were sent to all Range Management Education Council members asking for statistics. In addition, each RMEC member was asked to compile a list of non-member schools that offered range training in its state. All college catalogs on file at the Texas Technological College Library were searched for evidence of range training and questionnaires were sent to all schools whose catalog indicated at least one course in range management.

In addition, questionnaires were sent to junior colleges listed in the Health, Education, and Welfare publication of colleges teaching agriculture (Brunner, 1960) to determine if any junior colleges were teaching range management or offering pre-range management counseling.

The survey revealed that 18 institutions offered range management degrees recognized by the Range Management Education Council, 13 additional schools offered range degrees or sufficient courses in range management to meet civil service standards, 32 additional schools taught some range work, but not enough to meet civil service standards, and 16 colleges offered pre-range management counseling.

Enrollment in RMEC Schools

The largest number of range management students are in RMEC member schools. The survey showed a total of 776 undergraduate students enrolled in curricula similar to those discussed by Heady (1961) in the 18 range schools (Table 1). Of these, there were 197 juniors and 217 seniors. Although most schools reported some freshman and sophomore students, the figures for the lower two grades do not reflect the true enrollment in lower division classes in range management. Many schools have a uniform curriculum for one or two years and the major is not designated until students are juniors. There were 100 graduate students enrolled in M.S. and Ph.D. programs at 16 of the RMEC schools.

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[1] *This is a condensation of a report by the author, Charles E. Poulton, and Joseph H. Robertson. The author is grateful for review by Drs. Poulton and Robertson and the entire Range Management Education Council. Thanks are due to the many representatives of educational institutions who supplied material for the report. However, the author assumes complete responsibility for errors, omissions, or mis-interpretation of material.*

Table 1. Enrollment by classes at Range Management Education Council Schools during 1963-64.

School	Fresh.	Soph.	Jr.	Sr.	Grad.
Univ. of Arizona	5	10	9	10	19
Brigham Young Univ.	17	15	8	7	2
Univ. of California	2	2	6	5	6
Colorado State Univ.	....	15	25	15	2
Ft. Hays State College	12	15	16	18	4
Univ. of Idaho	....	....	13	11	6
Montana State College	....	13	7	8	2
Montana State Univ.	....	....	8	10	2
Univ. of Nebraska	3	2	6	6	....
New Mexico State Univ.	18	13	12	14	2
Univ. of Nevada	....	1	2	1	14
Oregon State Univ.	4	3	8	5	11
So. Dakota State Univ.	....	6	3	5	....
Texas A & M Univ.	22	11	11	26	[1]
Texas Tech. College	11	17	18	14	6
Utah State Univ.	13	16	26	48	22
Washington State Univ.	4	4	7	4	....
Univ. of Wyoming	5	5	10	10	[1]
TOTAL	115	148	197	217	100

[1] Graduate students not reported.

Records at most institutions show that junior, senior, and graduate students eventually graduate. Therefore, only these students were used in compiling trends. Enrollment in advanced classes increased by about one-half in the last five years (Table 2). Junior enrollment increased 50%, senior 51%, and graduate 61%. Table 2 shows consistently more seniors than juniors the previous year. Likewise, the junior classes reported in Table 1 are generally larger than previous sophomore classes. These data reflect the large number of students transferring into range management from other disciplines, some even as late as their senior year. A recent graduating class of 14 range management students at Texas Technological College had only one student who had started his college work in his major field. In addition, many graduate students in range management do their undergraduate work in some closely related field.

Table 2. Trend in enrollment figures of junior, senior, and graduate range students at RMEC schools during the past five years.

Year	Junior	Senior	Graduate
1960	131	139	62
1961	132	143	64
1962	176	152	71
1963	194	171	85
1964[1]	197	217	100

[1]Estimates based on reports of schools in April, 1964.

Although senior enrollment for the past 5 years was up 51%, this increase was not uniformly distributed among schools. Schools reporting a substantial increase during the past 5 years are California, 33%; Ft. Hays State College, 39%; University of Nebraska, 100%; New Mexico State University, 100%; South Dakota State College, 25%; Texas A & M University, 73%; Texas Technological College, 360%; and Utah State University, 41%. All but two of these schools are in the Plains or Southwest, where less emphasis is placed on government employment than in the mountain and far-western schools. Enrollment increases were greatest in states with relatively large amounts of privately owned land.

The majority of range graduates are produced by a few schools. One school, Utah State University, had 22% of the seniors in the survey. The top 6 schools furnished 62% of the seniors and 10 schools had 82% of the senior enrollment.

The number of degrees in range management from the 18 RMEC member schools steadily increased during the past 5 years. A total of 643 B.S. degrees, 135 M.S. degrees, and 38 Ph.D. degrees were awarded during the period 1960-64 (Table 3). Schools vary from a high of 127 B.S. degrees to a low of 3 during the 5 year period. Six schools awarded 71% of the masters degrees, although 16 of the 18 schools offer graduate work in range management. Undergraduate degrees in range increased 48% during that time, masters degrees, 88%, and Ph.D. degrees remained relatively static (Table 4). The increase in undergraduate degrees in 1964 over 1963 was the greatest for the 5 year period.

Table 3. Total number of degrees granted by RMEC member schools, 1960-64.

School	B.S.	M.S.	Ph. D.
Univ. Arizona[1]	22	15	6
Brigham Young Univ.[2]	4	....	....
Univ. of California[1]	16	14	5
Colorado State Univ.[2]	74	9	....
Ft. Hays State Coll.[2]	57	21	....
Univ. of Idaho[1]	31	7	....
Montana State Coll.[2]	31	6	....
Montana State Univ.[2]	24	2	....
Univ. of Nebraska[2]	9	1	....
N. Mex. State Univ.[2]	23	2	....
Univ. of Nevada[2]	3	6	....
Oregon State Univ.[1]	10	5	4
So. Dak. State Univ.	21	....	....
Texas A & M Univ.[1]	80	10	6
Texas Tech College[2]	40	2	....
Utah State Univ.[1]	127	19	7
Wash. State Univ.	20	....	....
Univ. of Wyoming[1]	50	16	10
TOTAL	643	135	38

[1]Institution offers Ph.D. and M.S.
[2]Institution offers M.S. only.

Table 4. Degrees granted in range management at RMEC member schools during the past five years.

Year	B.S.	M.S.	Ph.D.
1960	106	16	5
1961	124	27	6
1962	128	33	10
1963	128	25	9
1964	157	34	8
TOTAL	643	135	38

Seven RMEC schools offer doctorate degrees in range management. Six of the schools gave from 4 to 10 doctorates. One school, the University of Idaho, awarded no Ph.D. degrees during the 5 year period. However, their doctorial program began in 1960 and they have 4 Ph.D. candidates nearing completion of their work.

Enrollment at Non-RMEC Schools Offering Major Work in Range Management

Not only are enrollments increasing in most RMEC schools, but large numbers of students are qualifying for civil service employment at non-RMEC schools. Civil service requirements are so low that only six hours of "range management" plus some supporting work will "qualify" an individual for range work.

Thirteen schools reported that they offered work qualifying graduates for civil service positions in range management. The amount of work in range management varied greatly between the schools. Apparently some rather strong curricula, perhaps equal to those now in the Range Management Education Council exist. Others simply offer enough range courses to qualify their graduates for government positions. Actual course offerings in range varied from the minimum of 6 semester hours to 16 semester hours (Table 5).

In all schools except one, the range management courses are offered in the home institution. Stephen F. Austin College reported that beginning in 1965 its forestry students would be sent to Texas A & M University for one semester for special training in range management. In most cases, the range courses are taught by one individual, although some schools did indicate that two or more instructors were used.

Since syllabi of courses were not specifically requested in the survey, it is impossible to report subject matter coverage in the courses. Eight non-RMEC schools listed Stoddart and Smith (1955) as their text for one of the courses, three listed Sampson (1952), two Humphrey (1962), two Hitchcock (1950), and several others listed local flora or forestry texts. From the selection of texts alone, it can be assumed that course work varies greatly among schools.

Table 5. Junior and senior students enrolled in courses leading to civil service qualification at non-RMEC schools during 1963-64.

School	Jr.	Sr.	Hrs. Range
Abilene Christian College (Tex.)	10	6	12
Arizona State College	8	6	12
California Polytechnic College (San Luis Obispo)	14	12	6.67
Humboldt State College (Calif.)	20	15	6
Kansas State College	8	3	9
McNeese State College (La.)	15	15	6
North Dakota State	....	18	12
Oklahoma State Univ.	9	9	16
Iowa State Univ.	8	8	6
Southwest Texas State	7	5	9
Stephen F. Austin (Tex.)	....	....	....
Sul Ross State (Tex.)	4	4	8
Univ. of Arkansas	2	1	6

The title of the degrees and the administrative department in charge of the curriculum varied greatly among non-RMEC schools. Only one offers a degree in range management. Five give the degrees in agronomy with an option in range management, 3 give degrees in forestry, 2 in general agriculture, and one each in wildlife management and botany. Six of the 13 schools are in states which do not have institutions offering a major in range management. Other schools are in states having one or more schools offering range management degrees. All except one are state supported schools.

Almost one-third of the total senior enrollment, 102 students, meeting civil service qualifications in range management were in non-RMEC schools. The non-member school with the largest senior enrollment had more seniors than all but 3 of the member schools. Four non-member schools had senior enrollments greater than 11 member schools.

Almost all non-RMEC schools showed interest in the Council. Only 2 of the schools surveyed gave a flat "no" to the question of possible interest. Most of the schools showed interest in improving their curricula.

The 100 seniors and 104 juniors in non-RMEC schools may be expected to fill a large portion of the range jobs available. Some graduates may be well qualified; others may have received only a minimum amount of range work from a teacher who has never had a range course himself, has never conducted research in range, nor has attended a single professional meeting in range management.

Since most schools are interested in improving their curricula, there is a fertile field for the RMEC in working with these institutions. Likewise, an average of 7 new Ph.D.'s is turned out in range each year who could be used to teach in these institutions.

Schools Teaching Range as a Service Course

A total of 32 schools reported some range work as a service course for other disciplines (Table 6). Ten schools reported range courses taught in the forestry departments, 8 schools taught range in the agronomy program, 8 taught it as animal science, and 2 taught it as botany.

Considerable interest in the range education survey was shown by the schools offering only a single course. This interest was particularly evident among the forestry schools. Most schools not only returned the

Table 6. Colleges and universities teaching at least one course in range management.

Institution	Avg. Enrollment	Semester Hrs. in Range
Arizona State Univ.	18	3
Auburn Univ.	25	3.33
California Polytechnic (Pomona)	15	4
Chico State College (Calif.)	55	3
College of Southern Utah	15	3.33
Duke University	4	2
Eastern New Mex. State	15	3
Ft. Lewis State (Colo.)	15	3.33
Fresno State (Calif.)	20	3
Fullerton Junior College (Calif.)	16	4
Hartnell College (Calif.)	....	3
Imperial Valley College (Calif.)	17	3
Louisiana State Univ.	35	3
Northern Montana College	10	3.33
Panhandle A & M College (Okla.)	25	4
Michigan College of Mining & Tech.	25	3
Michigan State Univ.	40	3
Orange Coast College (Calif.)	18	3
Penn. State Univ.	25	3
Porterville College (Calif.)	10	3
Reedley Jr. College (Calif.)	10	4
Sam Houston State College (Tex.)	....	3
State Univ. of N. Y.	28	3
Texas Christian Univ.	20	3
Univ. of Georgia	40	3
Texas A & I College	15	3
Univ. of Missouri	....	3
Univ. of Washington	10	5
Univ. of West Virginia	....	2
West Texas State Univ.	15	3
Univ. of British Columbia	....	....
Univ. of Chihuahua	....	....

questionnaire, but many wrote letters explaining their offering in range. Professor George Thompson of Iowa State University indicated that he had surveyed forestry schools in the U. S. on their range offerings and was preparing a paper for the Journal of Forestry reporting his results.

Credit for service courses in range management ranged from 2 to 5 semester hours. Many times it was difficult to tell what is taught in the courses. Ten schools listed Stoddart and Smith (1955) as their major text, 3 listed Sampson (1952), and others listed various texts in agronomy, forage crops, wildlife management, and forestry.

An average of 501 students per year are exposed to range management as a service course in schools not offering major work in range management. No attempt was made to determine the number of students taking at least one range course in schools offering major work in range management. However, it is apparent that well over 1000 students are exposed to some work in range management each year. Evidently, there is much variation in the type of work that students receive in their "range management" courses.

Foreign Universities Offering Range Training

Catalogs from the University of British Columbia and the University of Chihuahua indicate that courses in range are taught in those institutions. In addition, several special programs are offered in the Middle East, Africa, and South America. However, since programs in other countries are considerably different from those in the United States, no attempt was made to determine the equivalent semester hours taught.

Range Work in Junior Colleges

Little can be reported on range work in junior colleges. First, few of the questionnaires were returned. Second, there is no standard pre-range course such as for pre-medical, pre-veterinary, or even pre-forestry students.

Seven junior colleges teach a course in range management. Another 16 reported that they offer pre-range work. In most cases this pre-range work consists of basic science courses plus counseling from the instructor as to the degree requirements in range management at some school with which the instructor is familiar. Many times this school may be his *alma mater* or some nearby college. It appeared that pre-range counseling was offered only where the agriculture or botany teacher was range oriented and had some exposure to the field himself.

Junior colleges offering pre-range counseling are located in 5 states: 6 in California, 6 in Texas, 2 in Utah, and one each in Colorado and Nebraska. Several other junior colleges indicated that they did not separate their pre-range students from the pre-forestry curriculum, which is much better established.

Vocational Training in Range

Texas Christian University has a unique program in range management. Although it offers only one college credit course in range, it has a yearly range management institute for vocational training. The program does not carry college credit, and is designed especially for students desiring a terminal program at the vocational level. Normally 20 students per year take the extensive, practical training and return to their ranches.

Several junior colleges wrote notes indicating plans for initiating two year terminal training in range management. Judging from the comments of junior colleges and the success of the Texas Christian University program, there is a need for vocational training in range for students who, for some reason, cannot take a college degree.

One apparent difficulty in the vocational approach is that it handicaps the able student who later decides to take a degree in range management. Texas schools have already encountered the problem of students transferring from the Texas Christian University with many hours of range management that

cannot be counted toward a degree. If additional vocational programs are initiated, administrators in charge of the programs must be extremely careful in their counseling in order to prevent subsequent loss of time and credit to students who may eventually continue their range work for college credit.

Some Problems in Range Education

Range management enrollment in the United States has shown a considerable increase during the past 5 years. In addition to a 51% increase in senior enrollment in RMEC member schools, range work in nonmember schools has grown steadily.

Students from non-RMEC schools now make up almost one third of the total enrollment. While many of the schools have good curricula, there is much variation in the offerings. Judging from the reported texts used in range courses, the concept of range varies from agronomy, wildlife, or forestry to that commonly held by RMEC member schools. An employer, when hiring from some schools, may not know whether he is getting a range man or a man qualified by six semester hours of something called range management taught by a professor of dairy science.

Apparently, the strong demand for range trained individuals has led to some minimal offerings and low standards. Civil service standards are set to allow maximum availability of personnel. Many times, as in the case of range, these minimum standards are below that acceptable to the profession. These minimum standards then become the maximum for some institutions seeking employment for their students.

The problem becomes more acute when the availability of qualified professors for the range programs is considered. There are 63 schools in the United States teaching at least one course in range management. Many schools have several range men on their staff. Only 38 doctorates have been awarded in the past 5 years, and only a limited number prior to that time. Research institutions compete for the terminal degree candidate. Consequently, many schools which should hire a range Ph.D. settle for an agronomist, a botanist, or a forester and the problem of range education is confounded rather than solved. Even among RMEC schools the problem is acute. The move of only one man in a key school may set off a reaction that will ultimately involve 4 or 5 schools. This demand for experienced range teachers has established a tendency in some schools offering service courses to have nonrange personnel teach range courses rather than run the risk of serving as a training ground for professsors in range schools.

Even though total enrollment in range schools is increasing, demand for range graduates is also increasing. Fewer students are looking to the government for employment as more jobs in private industry become available. If the current trend continues, there should be plenty of students from range schools to fill range jobs. Competition for the good student will probably increase as more private jobs become available, and the poor student may have to take a second choice job.

The large number of students from schools with apparently low standards will also be in the employment market. The range profession must take action to see that all students, regardless of school, who call themselves range men have training acceptable to the profession. This will involve education of educators themselves that minimum civil service standards are not acceptable standards for measuring a range manager.

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Range Plant Judging Contest

Range Plant Judging Teams get ready! The contest is scheduled to be held at the Dunes Hotel, Las Vegas, Nevada, on Tuesday, February 9, at 8 A.M. Look for full details in the November Journal of Range Management.

Cost of Tree Removal Through Chemicals[1]

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Highlight

Four things must be known to estimate cost of chemical tree treatment: labor performance rates, quantity of material, wage rate, and unit cost of material. Labor and material requirements are related to tree diameter, stand density, and species treated.

Density of tree cover is a major determinant of forage production in woodland-grass ranges. Heavily wooded areas support only a sparse herbaceous understory of less desirable forage species; whereas, open woodlands with widely scattered trees may be as productive as open range. Thus, removal of trees from denser areas may result in both improved forage quality and increased forage production. Murphy and Crampton (1964) reported that forage yield under chemically treated blue oak *(Quercus douglasii)* at Hopland exceeded that of open ground the growing seasons following treatment. Natural revegetation may be relied on or seeding with desirable forage species may be carried out to vegetate cleared areas. Although trees may be removed by felling or by the use of bulldozers, these methods are, under certain conditions, prohibitive in cost. Estimated costs of $80 to $200 have been reported by the California Agricultural Extension Service (Berry, et al., 1955). Accordingly, much attention has been focused on the use of chemicals as a more economical method of removing trees (Johnson, et al., 1959 and Leonard, et al., 1956).

This article is concerned with the cost of chemical tree treatment based on data collected at the University of California's Hopland Field Station in southeastern Mendocino County between December 1959 and April 1960. Four 1-acre plots of densely wooded grass range were treated with 2,4-D applied by injector-type applicators. The diameter, species, treatment time, and moving time between trees were recorded for each plot and regression analyses of these data provided estimates of the influence on treatment and moving time of species, diameter of trees, and density of stand.

Material and Labor Costs

Costs of such treatment include chemical materials and labor. Per acre costs for materials vary with the type and concentration of chemicals used as well as with the number and diameter of trees treated. The use of 2,4-D at the rate of 0.075 ounce of actual chemical per inch of diameter has proved to be effective for most of the trees and larger shrubs in woodland grass areas (Leonard, et al., 1956).

Per acre costs for labor include time spent in actual application of chemicals,[2] in moving between trees, and in mixing chemicals and filling chemical applicators. In addition, there is time wasted or lost. Regression analysis indicates that the diameter and species of trees treated largely influence the time necessary for actual chemical application (Table 1). First, the data indicate that treatment time for all species increases linearly with increases in the diameter of trees treated. Second, by holding diameter constant, it is clearly evident that there are significant differences in treatment time between species, arising from their individual growth habits. For example, blue oaks and small diameter black oaks are quickly treated because they have relatively thin bark and isolated main stems.. Large diameter black oaks, however, have long treatment times because their thick and spongy bark not only impede penetration to the cambium layer but also clog the chemical ports of the injector tool. Live oaks and madrones also have long treatment times because they grow in clumps with as many as 8 main stems coming from a limited base area. And, during the treatment of any one stem, adjacent stems obstruct and thus prolong frilling and applying chemicals. (Thick bark on large diameter live oaks make treatment additionally time consuming.) Manzanitas have long treatment times because they often grow low and parallel to the ground, making treatment on the undersides of the main stems a slow process.

Additional regression analysis indicates that the time spent moving between trees varies with density, that is, the number of stems per acre (Table 2). As one would expect, moving time increases linearly with increases in the number of trees treated per acre, that is, with increased

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[1] *Giannini Foundation Paper No. 254.*

[2] *Includes making axe frills and applying chemicals or using injector-type applicators.*

Table 1. Labor time for chemical application in seconds per tree.

Species	Diameter of trees — inches						
	4	5	6	7	8	9	10
Blue oak	11.7	14.3	17.0	19.6	22.3	25.0	27.6
Black oak	12.9	19.0	25.1	31.2	37.2	43.3	49.4
Live oak	23.5	30.1	36.7	43.3	49.9	56.5	63.1
Madrone	28.2	31.8	35.5	39.1	42.7	46.3	50.0
Manzanita	25.3	31.3	37.3	43.3	.....	.....	.....

density. However, moving time does not increase proportionally with density. For example, as the number of trees per acre increases five times the moving time increases only three times.

The labor required in mixing chemicals and filling applicators, including lost or wasted time, averaged about 35 percent of the total labor time per acre.

Effect of Species, Diameter, and Density

Relationships between tree species, diameter, and total per acre costs are indicated in Table 3. For all species, estimated per acre costs increase with increases in the diameter of trees treated. For small diameters, total per acre costs of treating live oaks, madrones, and manzanitas are consistently higher than those for treating blue oaks and black oaks of comparable diameters. However, at large diameters, per acre costs of treating black oaks approach those for treating large diameter, live oaks, madrones, and manzanitas. These cost estimates are based on a density of 120 trees per acre, labor costs at $1.50 per hour, 2,4-D applied at a rate of 0.075 ounce per inch of tree diameter at a cost of $1.05 per pound.

The effect of tree density on cost of treatment is illustrated in Table 4. Estimated per acre cost of treating blue oaks of the same average diameter increases from $2.45 when 50 trees are treated to $7.20 when 150 trees are treated Table 4, part A). This increase in cost results from the longer time spent moving between trees in the denser stand and from the greater cost of materials used in treating the larger total diameter of the denser stand. The cost of treating 50 blue oaks with average diameter of 20 inches is $6.63 while the cost of treating 150 blue oaks with average diameter of 6.6 inches (holding total diameter of all trees the same) costs $6.85 (Table 4, part B). Theoretically, the cost of materials in both treatments is the same since the total diameters treated are identical. Granting this, the difference in cost of treatment results mainly from the increased moving time within the denser stand.

Table 2. Effect of number of trees treated on moving time.

Number of trees treated per acre	Moving time in minutes per acre[1]
50	5.5
100	8.1
150	10.7
200	13.3
250	15.9

[1] Moving time in minutes (Y) as a function of number of trees treated (X) on the Hopland experiment can be expressed as $Y = 2.95 + 0.052\,X$; $r = 0.86$; $t = 8.305$.

Discussion

In summary, four things must be known to estimate the cost of chemical tree treatment: labor performance rates, quantity of material used, the wage rate, and the unit cost of the material used. Wage rates and material costs are generally easily ascertained. Labor performance rates and material requirements have been shown to be determined by diameter of trees treated, the density of the stand, and the species and are typically estimated in terms of hours and gallons per acre respectively. No allowance for variation in labor productivity has been incorporated in the cost estimates included in Tables 3 and 4 though this additional variable can be easily introduced.

As is often the case with other

Table 3. Cost per acre for chemical tree treatment by species and diameters[1]

Diameter of trees treated	Total per acre cost of treatment				
	Blue oak	Black oak	Live oak	Madrone	Manzanita
	(Dollars)				
3	2.69	2.54	3.22	3.74	3.60
5	4.23	5.15	5.34	5.41	5.35
7	5.77	6.95	7.37	7.09	7.07
9	7.30	8.75	9.43	8.75	.....
11	8.85	10.56	11.50	10.42	.....

[1] These estimated costs are based on the following conditions: density of 120 trees per acre, labor at $1.50 per hour, and 2,4-D applied at a rate of 0.075 ounce per inch of tree diameter at a cost of $1.05 per pound.

Table 4. Effect of number of trees per acre and average tree diameter on costs of chemical treatment of blue oak.

Blue oak trees per acre	A			B		
	Average diameter	Total diameter	Cost of treatment	Average diameter	Total diameter	Cost of treatment
(Number)	(Inches)		(Dollars)	(Inches)		(Dollars)
50	7	350	2.45	20.0	1,000	6.63
75	7	525	3.65	13.3	1,000	6.68
100	7	700	4.85	10.0	1,000	6.75
125	7	875	6.00	8.0	1,000	6.80
150	7	1,050	7.20	6.6	1,000	6.85

types of range improvement practices, little information is available on which to base expectations of increased grazing capacity following tree removal. Darrow and McCully (Darrow, et al., 1959) report a fivefold increase in forage production with complete treatment and a twofold increase with partial treatment. Average yields per acre of oven dry forage, for 3 years after treatment, increased from 222 pounds to 504 and 1,290 pounds for partial and complete treatment, respectively. Following the treatment of a stand of blue oaks with 2,4-D Johnson et al., (1959) report that density of herbaceous vegetation increased from 35 percent to 70 percent and contained a higher proportion of desirable annual grasses. And, average production of dry matter per acre increased from 278 pounds to 1,409 pounds. Similarly, although forage production was not measured, visual observations on the Hopland plots show pronounced increases in the quantity of forage grasses (Figure 1).

Tree removal, as a type of range improvement, yields no significant change in season of use where increased production is through natural revegetation. However, observations do indicate that green forage under a tree canopy is available earlier as well as later than the forage in open areas. Thus, while forage production was not measured in connection with data reported here, it seems that although total forage production can be increased by complete tree removal, leaving a few trees may result in a somewhat longer grazing season on green feed.

FIGURE 1. *Left:* Two different sections prior to treatment in December 1959. *Right:* Same sections, respectively, in January 1963, three years after treatment. Note increase in understory vegetation.

Summary

Density of tree cover, a major determinant of forage production in woodland-grass ranges, can be changed by chemical treatment of individual trees. Labor and materials costs, the essential cost components, are determined by the quantity of labor and materials used and their prices. Labor and material requirements are functionally related to diameter of trees treated, density of stand, and species treated. Therefore, costs per acre to treat trees can be related to these same variables and, additionally, to the prevailing wage rates and cost of chemical material used.

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Seeding Western Wheatgrass with Increasing Rates of Perennial Ryegrass or Smooth Brome in Waterways[1]

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Highlight

Western wheatgrass was planted at 8 lbs. per acre with increasing rates of perennial ryegrass and smooth brome in a new waterway. Perennial ryegrass increased until the second or third season, then was replaced by western wheatgrass. Smooth brome increased and dominated all plots. It seems advisable to use short-lived, unadapted plants such as perennial ryegrass as companion species to western wheatgrass.

Western wheatgrass (*Agropyron smithii* Rydb.) occurs as a major dominant in many western Kansas waterways. Atkins (1957) reported that although slow to become established, western wheatgrass eventually produces a dense, thrifty sod more suitable for waterway protection than many tame grasses. Tame grasses establish quickly but often require intensive management to maintain adequate cover (Cooper, 1957).

Since rapid coverage and lasting soil protection are both desirable in establishing grassed waterways, planting a tame species with western wheatgrass in the proper combination was postulated as a means of obtaining both objectives i.e. rapid initial coverage by a tame species and in time, permanent coverage by western wheatgrass through plant succession. This study compares plantings of western wheatgrass seeded at a constant rate with increasing rates of each of two tame grasses having different growth habits, namely perennial ryegrass (*Lolium perenne* L.)—a bunchgrass, and smooth brome (*Bromus inermis* Leyss.)—a sod forming species. Specific objectives were to determine the effects of tame-species planting rates on first-year seedling numbers, and to record foliage cover and species composition changes in relation to initial stands under waterway conditions. Results of planting in 1959 and cover changes during five successive growing seasons are reported and discussed.

Experimental Area and Methods

Luebs (1962) described the experimental area on the Fort Hays (Kansas) Branch Experiment Station at Hays. The soil is silty clay loam, representative of many upland areas in north-central Kansas. The site had a cropping history of wheat, sorghum, and summer fallow for nearly 50 years previous to this experiment. Native vegetation on similar soils consists of buffalograss (*Buchloë dactyloides* [Nutt.] Engelm.), blue grama (*Bouteloua gracilis* [H.B.K.] Lag. x Steud.), and western wheatgrass in varying mixtures. Species composition is influenced to a large extent by intensity of livestock grazing (Launchbaugh, 1957).

Mean annual precipitation for the area is 22.94 inches, with an average of 17.74 inches during the growing period, April to October. There were significant moisture deficits the first five months of 1962 and from October, 1962, to July, 1963, otherwise drought periods were infrequent and of relatively short duration, especially during months of most active plant growth. Summer temperatures generally were slightly lower than the mean, while winter temperatures frequently were 10 to 15 degrees below long-time means.

A waterway was shaped and berms constructed during the winter of 1957-58. Although the site possessed natural drainage, it was necessary to move several inches of topsoil from the center to the berms to create a uniform channel. Thus in shaping, site qualities of the channel were altered in relation to the side slopes where topsoil was deposited. Ellis forage sorghum was sown thickly on the waterway in July, 1958. Average production was approximately 4,000 pounds of dry matter per acre, which was left undisturbed for seedbed cover. Grass was planted April 15, 1959, using a four-row plot drill equipped with double-disk planters, packers, and V-belt seed conveyors to distribute known quantities of seed evenly in a prescribed length of row. Seed placement was ½ to ¾ inch deep in one-foot row spacings. The experiment consisted of two whole plots (in which the seeding rate of western wheatgrass was constant at 8 pounds per acre) and eight subplots each for perennial ryegrass and smooth brome at increasing rates from 0 to 24 pounds per acre in combination with western wheatgrass. Planting rates in pounds per acre and in terms of calculated viable seeds (PLS) per foot of row are shown in Table 1. Subplots were 12 rows, 16 feet long. The planting mixtures were replicated in three randomized blocks for each whole plot. Two replications were located on the sloping sides of the waterway where soil was deposited and the third in the channel area where topsoil was removed. Planting was done at right angles to the longitudinal axis of the waterway.

Sampling included seedling counts at the end of the first growing season in 13-foot seg-

[1] *Contribution No. 189, Fort Hays Branch, Kansas Agricultural Experiment Station, Hays, Kansas.*

Table 1. Rates of companion species planted with western wheatgrass seeded at a constant rate of 8 pounds per acre or approximately 12 PLS[1] per foot of row.

Planting rates of companion species	Approximate PLS[1] per foot of row	
	Perennial ryegrass	Smooth brome
(lb./A.)	— — (number) — —	
0	0	0
½	2	1
1	4	2
2	8	4
4	16	8
8	32	16
16	64	32
24	96	48

[1]Pure live seed estimated from purity and germination analyses.

ments of each row, and foliage cover estimates by species based on the means of six independent ocular estimates per subplot by two observers each fall for five seasons.

Results

First-year Seedling Numbers.—Seedlings of all species began to appear by late April, 1959, and continued to emerge during May. Total numbers on September 1, 1959, are shown in Table 2. Initial stands of western wheatgrass were highly variable and were influenced significantly only by the highest seeding rates of perennial ryegrass and smooth brome. Individual rows contained from one to 10 western wheatgrass seedlings per 13 feet, in most instances with no apparent relationship to the abundance of companion seedlings. Both companion grasses produced seedling numbers in linear proportion to the planting rates, with highly significant positive correlation coefficients of over .90. Average number of viable seeds needed to obtain one seedling by species follows: perennial ryegrass, 17; smooth brome, 21; and western wheatgrass, 56. Considerable differential in the ability of the various species to emerge and persist under similar field conditions is indicated, or questionable relationships exist between seed quality analyses and responses to field planting conditions. In addition to producing more seedlings per unit of viable seed, the tame species produced considerably more uniform stands than did western wheatgrass.

Foliage Cover and Species Composition.—All species increased by tillering. Figure 1 shows the changes in foliage cover during five successive growing seasons. Important differences in total cover were manifest during the first and second seasons when plots containing western wheatgrass alone and the lower populations of tame species had much less coverage than those with the higher densities of perennial ryegrass or smooth brome. By the end of the third season, coverage was nearly the same regardless of companion species seeding rate. Thereafter, total foliage cover apparently was influenced by growing conditions rather than original seedling numbers.

Species composition changes during the five years were influenced by companion species and initial proportion of seedlings. Western wheatgrass was relatively very low in amount at the end of the first growing season, especially at the higher seeding rates of perennial ryegrass and smooth brome. However, the wheatgrass increased consistently at the expense of perennial ryegrass and was the only species present after four growing seasons. Western wheatgrass associated with various amounts of smooth brome, on the other hand, increased in percentage to the third and fourth growing seasons then decreased in relative coverage. At the end of the fifth growing season, smooth brome dominated all plots where it occurred in the planting mixture except those at the half pound per acre rate. There it nearly equalled western wheatgrass.

Table 2. First-year seedlings resulting from planting western wheatgrass at a constant rate in separate mixtures with two companion species at various rates.

Planting rates of companion species		Seedlings produced by:			
		Western wheatgrass	Perennial ryegrass	Western wheatgrass	Smooth brome
(lb./A.)		— — — —	(Number/100 feet of row)		— — — —
0		25	0	26	0
½		36	25	16	5
1		28	38	18	9
2		42	51	14	18
4		37	132	14	27
8		21	236	21	116
16		19	394	15	137
24		3	442	8	213
L.S.D.	.05	18	.....	13	.....
r(seeding rate and seedling number)		....	.99**	....	.94**

Discussion

Apparently the tame grasses used may be included with western wheatgrass over a wide range of planting rates without having appreciable effect on first-year seedling numbers of western wheatgrass. This may be true, however, only if western wheatgrass and the companion species emerge simultaneously, as in these trials. Studies of competition between reseeded annual ryegrass (*Lolium multiflorum* Lam.) and several perennial grasses, reported by Schultz and Biswell (1952), showed that when annual ryegrass emerged from three to seven weeks before the perennials, there were

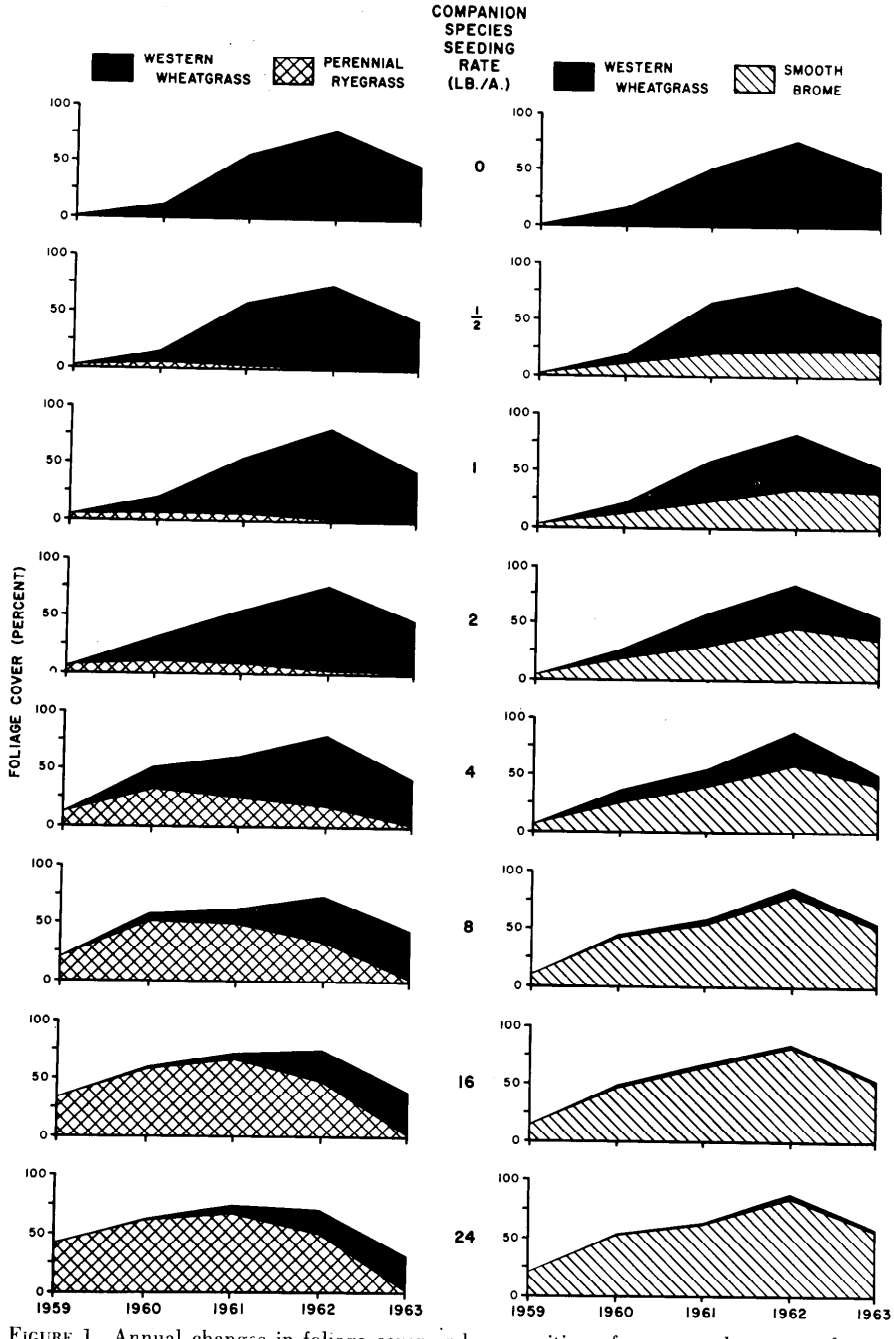

FIGURE 1. Annual changes in foliage cover and composition of western wheatgrass alone and in separate combinations with various planting rates of perennial ryegrass and smooth brome.

significant reductions in number and development of associated perennial grass plants. When already well established, annual ryegrass crowded out a large number of perennial grass seedlings throughout the growing season and retarded development of those that survived.

Rapid spread of persistent plants is desirable in all newly seeded stands. This is a primary objective in revegetating a waterway where excess runoff must be carried with minimum soil loss. The cover of western wheatgrass alone and with the lower rates of either companion species did not equal the desirable coverage resulting from high rate combinations until the end of the third growing season. Studies by McWilliams (1955) have shown that yields from light seeding rates are lower in new stands, but increase and become equal to or greater than yields from heavier seeding rates as the stands age. Presumably narrower row spacing would have compensated somewhat for paucity of stand within the row and resulted in more comparable total cover by the end of the second season regardless of initial stand. However, it appears that first-year stands of western wheatgrass, because of sparse populations and tillering, seldom would offer erosion protection comparable to mixtures with species that tiller profusely and are leafier. Older stands of western wheatgrass, unless grazed or mowed and raked cleanly, contain accumulated old plant residue in addition to current growth and appear to provide effective erosion protection under waterway conditions.

After various species are established, composition changes result from plant competition. The contrasting trends of succession noted in this study may have been due primarily to the competitive advantage of a rhizomatous species such as western wheatgrass over a slowly spreading bunchgrass in one case and the lack of such an advantage when two rhizomatous species were involved. Original plants of perennial ryegrass made only modest peripheral increases in basal coverage. Rows were evident in plots containing perennial ryegrass throughout the experiment. Western wheatgrass occupied the intervening row spaces and replaced perennial ryegrass as it died. In contrast, smooth brome tillered profusely and occupied the bare areas as readily or more so than western wheatgrass. Rows were not evident after the second growing season. The relatively dry springs of both the fourth and fifth growing seasons did not favor cool-season grasses. Perennial

ryegrass may have been more adversely affected by drought than either western wheatgrass or smooth brome. The fifth-season drought was about equally detrimental to both western wheatgrass and smooth brome.

The aggressiveness of smooth brome agrees with observations by Atkins (1957), that on waterways where soil fertility and permeability were favorable for the growth of tame grasses, increase in native grasses was slow in competition with smooth brome. Cooper (1957) stated that tame grasses such as smooth brome, in contrast to native species, eventually need intensive management including fertilization to maintain adequate cover for waterway requirements. A longer period of observation is necessary to determine the comparative staying qualities of western wheatgrass and smooth brome under the condition of this study.

These plantings, characteristic of newly reseeded areas, had varying densities of first-season annual weeds including kochia (*Kochia scoparia* [L.] Schrad.), pigweed (*Amaranthus* spp.), and several minor species. Weed densities were not high enough to smother the grass seedlings nor to influence their development significantly. If weed populations do not prevent the establishment of a desirable grass cover, their presence in the early stages may serve some purpose by adding to the total vegetation cover. Weeds persisted during the second year in plots with open grass cover, but were essentially absent from all plots thereafter.

Significant differences existed between replications in initial grass seedling numbers and subsequent total vegetation cover. The plots were located so that each slope below the berms constituted two replications and the channel area, a third. In each instance, seedling numbers and foliage cover estimates were lower in the center replication than in adjacent locations. Topsoil transfer during waterway construction and consequent alteration of site potential probably accounted for the differences observed.

Summary and Conclusions

Western wheatgrass was planted at a constant rate in separate combinations with increasing rates of perennial ryegrass and smooth brome in a newly shaped waterway at Hays, Kansas. Data on first-year stands and plant cover changes during five successive growing seasons are presented.

Western wheatgrass seedling numbers varied but were lowered significantly only by the highest rates and seedling densities of both companion species. Seedling numbers of companion grasses were in linear proportion to the number of viable seeds planted.

Foliage cover of western wheatgrass alone and with the lower seeding rates of tame grasses was less until the third growing season compared with plots containing higher seeding rates of introduced grasses. Total foliage cover was not influenced by original planting rates after the third growing season.

Two trends in plant succession were observed. Perennial ryegrass increased in foliage cover until the second or third season, then began to decline and was replaced completely by western wheatgrass before the end of the fifth growing season. Smooth brome, in contrast, increased rapidly and dominated the plots at all rates except the lowest by the end of the fifth growing season.

In view of these findings it appears that high initial coverage may be achieved by including tame species at high seeding rates with western wheatgrass. For plant succession to culminate in western wheatgrass dominance within a few years, it seems advisable to use a short-lived, unadapted species such as perennial ryegrass as the companion species, otherwise adapted, more aggressive tame species may delay or prevent the desired trend in plant succession.

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Vegetational Responses Following Winged Elm and Oak Control in Oklahoma[1]

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Highlight

Total herbage production increased significantly following 92 to 100 percent control of winged elm, oak, and hickory trees. This increase, however, was mostly in less desirable grass and forb plants, even on reseeded plots. Natural recovery of desirable grasses after brush control on this type in Oklahoma appears to be a slow process. Reseeding may speed up forage plant establishment, but more research is needed.

There are an estimated 10 million acres dominated by undesirable woody vegetation in Oklahoma (Elwell, et al. 1950). Much of the area in eastern Oklahoma is occupied dominately or subdominately by winged elm *(Ulmus alata)*. This species occurs from eastern Texas, Oklahoma, and Kansas to the coast of North and South Carolina and parts of Florida (Brush, 1918; Shipman, 1959).

Grass production is suppressed when woody vegetation is dense. Control of woody plants, primarily oak *(Quercus* spp.) in Oklahoma, releases the grasses for increased utilization by livestock. When the oaks are controlled, the elm is also released and increases in stature and abundance on the area. This frequently causes a problem more severe than the oak because of winged elm resistance to currently used foliar applied herbicides. Desirable grass stands are often very sparse on these wooded areas. Reseeding of desirable grasses may increase the chances for more rapid grassland improvement.

Some brush control research stresses the effect of herbicides upon the brush species treated (Frey, 1953; Waldrip, 1953). Other work emphasizes changes in herbage production, species composition, and stand density Crawford, 1960; Vogel and Peters, 1961; Dalrymple, 1961; Ehrenreich, 1959; and Elwell, 1953). Darrow and McCully (1959) stated that removal of brush overstory released moisture, light, and nutrients for use by more desirable range plants. Root plowing and reseeding increased the stocking rate from 33 to 5 acres per cow and also improved calf weights (Carter, 1958).

As hardwood crown cover decreases there is a corresponding increase in herbage production (Ehrenreich and Crosby, 1960). A release in both shortleaf pine *(Pinus echinata)* and grass has resulted when hardwoods were aerially treated with 2,4,5-T (Elwell, 1962). Seeding of desirable grasses following brush control has been shown to contribute considerably to herbage production (Dalrymple, 1961; Vogel and Peters, 1961).

The major objective of this study was to determine the effect of winged elm and oak control and grass seeding upon percent vegetational composition, basal cover, and herbage production. The rate of woody species increase or invasion was noted after chemical treatment. There was little desirable grass on the area at the outset. The herbaceous plants were fairly vigorous in openings, but were sparse and stunted under the tree canopy.

Materials and Methods

An area in southeast Oklahoma in the blackjack - post oak *(Quercus marilandica - Q. stellata)* vegetative type described by Duck and Fletcher (1943) was selected for the study. Species composition of the woody plants of the study area was 42 percent winged elm, 35 percent post and blackjack oak, 9 percent mockernut hickory *(Carya tomentosa)*, 5 percent sumac *(Rhus* spp.), and 9 percent other woody species. The soil was Enders loam (non-modal) with a solum depth of 11 to 35 inches.[2] The soil was classed as having low fertility with organic matter of 2.5 to 5.6 percent in topsoil and 1.0 to 2.6 percent in the subsoil. The pH (paste) of the topsoil and subsoil ranged from 5.0 to 5.7 and 4.6 to 4.8, respectively.

Precipitation and maximum-minimum air temperatures were recorded daily at the study site. The area is in the 40 to 45 inch rainfall belt. Precipitation for the growing season (April through October) was slightly above the 1931-1952 average for the area, but that for May and June was about half the long-time average. Precipitation for the 1963 growing season (April through August) was 7.42 inches below normal. Maximum and minimum air temperatures for the growing season of 1962 and 1963 exceeded the long-time average by 1 to 6 degrees Fahrenheit.

Three treatments and a check were applied in May, 1962 and were replicated five times on one-eighth acre plots (50 X 109 feet). They were:

1. "Check", all vegetation was allowed to grow and reproduce naturally.
2. All trees except very small seed-

[1] *This study was supported in part by Central Research Fund-1 contributing to Okla. Agric. Expt. Sta. Project 1146, in cooperation with Weed Investigations, Grazing Lands, Crops Research Division, A.R.S., U. S. Dept. Agric. Special recognition is given Mr. H. M. Elwell of the U.S.D.A. Crops Research Division at Stillwater, Oklahoma, for assistance and guidance throughout the study.*

[2] *Soil classification by L. C. Singleton, Soil Conservation Service, McAlester, Oklahoma.*

lings were basally injected with undiluted triethylamine salt of 2,4,5-T in late May, 1962. All other vegetation was allowed to grow and reproduce. This treatment is referred to as "natural recovery".

3. Trees were treated as in no. 2. The plots were then broadcast seeded by hand at the rate of 4.0 pounds pure-live-seed per acre of a native grass mixture primarily little bluestem *(Andropogon scoparius)* and Indiangrass *(Sorghastrum nutans)*. Seeding was done about one week prior to the 2,4,5-T treatment. This treatment is referred to as "native seeded".

4. Tree species were treated as above. The plots were then seeded as in no. 3, using 7.5 pounds pure-live-seed per acre of King Ranch bluestem *(Bothriochloa ischaemum)*. This treatment is referred to as "K-R seeded".

The brambles and small shrubs were cut near ground level with a scythe in late June, 1962, in the 2,4,5-T treated plots in an effort to reduce competition for better grass seedling establishment.

A 25 foot wide area was treated between check plots and injector treated plots, and around the ends and edges of a block. This was done to eliminate the effect of shading, moisture depletion, and nutrient use by untreated trees whose roots extended in to the treated areas.

Vegetational analyses were made at the initiation of the study and each fall of the two years following. A 50 foot line transect was used to determine species composition and basal cover of grass and grass-like species *(Cyperaceae* and *Juncaceae)*. Two permanently located lines were read per plot making 500 linear feet per treatment. Herbaceous vegetation was measured in millimeters. A 50 X 6 foot belt transect was used to determine species composition and apparent kill of tree species and large shrubs *(Rhus* spp.). Abundance of broadleaved herbaceous plants, woody species up to ½ inch diameter, and grass seedlings was determined using 10 square foot frames per plot (50 per treatment). Five equally spaced square foot frames were read on each side of the center line transect.

Five randomly located, 11.5 X 24 inch quadrats per plot, clipped at ground level, were used for herbage production determinations. Herbage was hand separated into the following categories: beaked Panicum *(Panicum anceps)*; rosette Panicums *(P.* spp.); big and little bluestem *(Andropogon gerardi* and *A. scoparius)*, switchgrass *(P. virgatum)*, and Indiangrass *(Sorghastrum nutans)*; broomsedge bluestem *(Andropogon virginicus)*, nimblewill *(Muhlenbergia schreberi)*; other grass species, grass-like plants, legumes, and other forbs. In K-R seeded plots King Ranch bluestem production was measured.

Duplicate samples for soil moisture determination were taken from the upper three feet of each treatment with a soil tube and hammer and oven dried at 105°C. for 24 hours. Soil samples were taken from all check plots and analyzed for pH, available phosphorus, organic matter, and nitrogen.

Results and Discussion

Available moisture in the upper three feet of soil was lower in the check treatment at all sampling dates except January 21, 1963, when soil moisture was high in all treatments (Figure 1). There was a general downward trend in soil moisture from April to September, 1963. During the last four months of 1963, the soil moisture in the check treatment was below the wilting percentage level while all other treatment had some available moisture, indicating the trees of the check treatment used more moisture than the herbaceous types of vegetation.

Winged elm, blackjack, and post oak varied from 64 to 83 percent of the total woody plant numbers which ranged from 3659 to 4936 stems per acre on the various plots. Tree kill in chemically injected plots was over 92 per cent in the fall, 1963. Hickory *(Carya* sp.) was somewhat resistant to the herbicide and required a re-treatment in 1962. Refoliation of some oak and hickory in 1963 resulted in a slightly lower percent kill in 1963 than 1962. The dead hickory and winged elm were decaying and falling about six months after treatment. No sprouting was evident on any treated trees.

Herbage Production — Total herbage production per acre (oven dry) for natural recovery, native seeded, and K-R seeded treatments was two to three times that of the check the first year (Table 1). This increased as much as seven fold in the natural recovery treatment the second year following treatment. The increased forage in the three treated plots was primarily less desirable grass and forb species. Forbs made up about half the yield of the K-R treatment in 1963. There was a decrease in the yield of the check in 1963, probably caused by soil

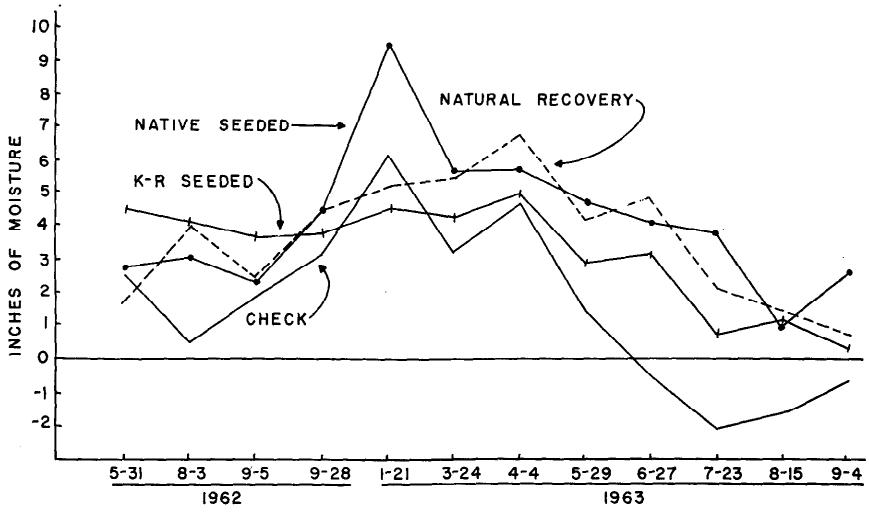

FIGURE 1. Inches of available soil moisture in the upper three feet of soil.

Table 1. Herbage production in pounds per acre oven dry. Clippings made September 3, 1962 and 1963.

	2,4,5-T Tree Injection Treatments							
	Check		Natural Recovery		Native Seeded		K-R Seeded	
Species	1962	1963	1962	1963	1962	1963	1962	1963
Rosette panicums	89	97	169	501	315	491	261	571
Broomsedge	50	41	137	191	402	184	77	79
Grass-like plants	60	49	124	120	35	64	186	46
Beaked panicum	31	14	96	92	13	23	60	65
Nimblewill	17	7	92	170	197	411	88	199
Age, Asc, Snu[1]	....	....	144	177	.....	2	.....	.....
King Ranch Bluestem	....	....	.....	.....	.....	.....	15	8
Other grasses	98	53	507	592	123	54	252	149
Forbs	124	87	76	570	119	330	245	1094
TOTAL	469	348	1342*	2413*	1204*	1559*	1184*	2211*

[1]Age, Asc, and Snu represent big bluestem, little bluestem and Indiangrass, respectively.
*Total production significantly greater than the check at the .01 level for all treatments and years.

moisture deficiency in the latter part of the growing season.

Grasses making up most of the yield were rosette panicums, broomsedge bluestem, grass-like plants, and "other grasses"; the other grasses were primarily slimspike threeawn *(Aristida longispica)*, poverty Danthonia *(Danthonia spicata)*, Virginia wildrye *(Elymus virginicus)*, fringeleaf Paspalum *(Paspalum ciliatifolium)*, bristlegrass *(Setaria* spp.), longspike Tridens *(Tridens strictus)*, purpletop *(T. flavus)*, and others. Forbs yielded a sizeable portion the second year in all treatments, primarily basketflower *(Centaurea americana)*, *Croton* spp., American burnweed *(Erechtites hieracifolia)*, white snakeroot *(Eupatorium rugosum)*, sunflowers *(Helianthus* spp.), prickly lettuce *(Lactuca scariola)*, Missouri goldenrod *(Solidago missouriensis)*, and wild legumes.

Seeding of native grass did not contribute to herbage yield the first year, but did slightly the second year. The decrease in K-R bluestem the second year may have been due to the adverse moisture relationships. The natural recovery treatment yielded more Indiangrass, big and little bluestem than did the native seeded treatment. Generally, all treatments yielded considerably more of each species than did the check (Table 1).

Basal Cover and Composition. —Basal cover of the check treatment decreased some the first fall (1962), but increased to about the same as the initial reading the second fall (1963) (Table 2). The initial reading of each treatment may be considered as a "check" for that treatment since it was made prior to the 2,4,5-T injection treatments. In the check treatment there was some change in species composition. Rosette panicums increased in percent composition while beaked panicum and nimblewill decreased the first and second fall.

An upward trend in basal cover was common in all tree injection treatments from less than one percent initially to 2.0 to 2.8 percent in 1963.

Percent species composition of beaked panicum decreased in 1962 but increased in 1963 in treatments other than the check because it occurs in large clumps and is not as widely distributed as the rosette panicums and other grasses. The more widely dispersed single or few stemmed grasses increased to many stems and accumulated a large area faster than the beaked panicum. In 1963 after the other grasses had made considerable increase, beaked panicum increased in area and in percent species composition.

Desirable grasses such as big bluestem, little bluestem, Indiangrass, and King Ranch bluestem tended to increase in the species composition, but were not dominant at any time. Native grass seedlings in the "native seeded" plots were not present until the second year and then made up only 3 per cent (Table 2). Seeding of K-R bluestem resulted in 2 and 5 percent of the species composition in first and second year, respectively.

Seeding of the grasses in mid-May, 1962, was somewhat later than desirable, as limited precipitation in May and June

Table 2. Percent basal cover and species composition of grasses and grass-like plants. Dates represent initial and final readings.

	2,4,5-T Tree Injection Treatments							
	Check		Natural Recovery		Native Seeded		K-R Seeded	
	6/4/62	9/3/63	6/4/62	9/3/63	6/4/62	9/3/63	6/4/62	9/3/63
Basal Cover	0.8	1.0	0.8	2.6	0.4	2.0	0.4	2.8
Species								
Beaked panicum	42	34	13	18	6	28	13	19
Rosette panicums	10	24	14	32	32	32	32	42
Nimblewill muhly	11	5	7	15	10	17	9	11
Broomsedge bluestem	5	8	4	12	7	7	....	4
Purpletop	....	....	22	6	3	4	1	9
Age, Asc, and Snu[1]	1	....	1	5	....	3	....	....
King Ranch Bluestem	....	....	....	....	....	....	....	5
Other grasses	2	2	5	3	2	1	3	3
Grass-like plants	31	27	35	10	39	8	42	8

[1]Age, Asc, and Snu are big bluestem, little bluestem, and Indiangrass, respectively.

caused adverse conditions for seed germination. Limited soil moisture during 1963 made conditions very unfavorable for grass establishment. During the second year the K-R bluestem plants were somewhat localized and in relatively large bunches. The native grass plants were in smaller clumps and more widely dispersed. The dispersion could have considerable influence on the increase in stand of these grasses in future years.

Abundance.—Number of K-R bluestem plants per square foot was 0.08 and 0.2 the first and second years, respectively. This was much lower than desired for proper grass establishment. Native grass seedlings were observed but did not appear in the sampling (Table 3).

At the end of two years, abundance of winged elm seedlings was much greater in the check treatment. This suggests that an increased grass stand competes with winged elm seedlings to the point of reducing or limiting elm stand density.

Generally, forbs increased in abundance in all tree injection treatments. Legumes, primarily *Lespedeza* species, increased in abundance the first year and decreased the second year. Stature of forbs was much greater in treatments of tree control. Some specimens of prickly lettuce and American burnweed were over 10 feet tall on plots where trees were killed.

Table 3. Abundance of small stemmed woody plants and forbs per square foot. Dates represent initial and final readings.

			2,4,5-T Tree Injection Treatments					
	Check		Natural Recovery		Native Seeded		K-R Seeded	
Species	6/4/62	9/3/63	6/4/62	9/3/63	6/4/62	9/3/63	6/4/62	9/3/63
Woody:								
Winged elm	.58	1.4	.56	.20	.40	.22	.78	.18
Oak spp.	....	0.6	.06	.02	.03	.04	.08	....
Other trees	.06	0.1	.06	....	....	.06	....	.02
Brambles	.32	.36	.28	.22	.42	.36	.48	.30
Shrubs and vines	.16	.02	.06	.16	.18	.12	.34	.52
Forbs:								
Croton spp.	....	.76	....	.10	....	.04	....	.04
American burnweed	....	....	....	.20	....	.40	....	.26
White snakeroot	....	.08	....	.06	....	.34	....	.04
Other forbs	1.48	.92	1.46	.94	1.58	.42	2.64	.54
TOTAL	**3.16**	**3.90**	**2.20**	**1.96**	**2.62**	**2.24**	**3.80**	**1.70**

Summary and Conclusions

Research was conducted to determine the effect of brush control and reseeding on herbage production, percent species composition of grasses, and relative abundance of forbs and small-stemmed woody plants. A check and the following three treatments were applied in May, 1962: natural recovery, native seeded, and King Ranch bluestem seeded. Trees were killed by 2,4,5-T injection on all treatments but the check. Observations were made on invasion of woody species and grass establishment by reseeding. Available soil moisture in the upper three feet of the profile of the check treatment was nearly always lower than that of the 2,4,5-T amine injection treatments. Soil moisture was below the wilting percentage four months of 1963.

A tree kill of 92 to 100 percent resulted in 2 to 3 times more total forage in the treated plots than the check the first year and as much as seven fold the second year. Most of the herbage yield was made up of less desirable grass and forb species. Basal cover of grasses increased from less than one percent initially to 2.0 to 2.8 percent the second year on the injector treated areas. There was more increase the second year than the first. Seeding of native grass did not contribute to yield or species composition until the second year. Seeded King Ranch bluestem made some contribution both years.

Big bluestem, little bluestem, Indiangrass, and King Ranch bluestem tended to increase in the species composition but were not dominant at any time. Grass-like plants decreased in percent composition. These changes show the response of the various species to the altered environment. Generally, all forbs increased in the 2,4,5-T injection treatments after the treatment. One forb, American burnweed, increased in the injection treatments each year but did not occur in the check at any time. Winged elm seedlings were much more abundant in the check treatment, suggesting that increased herbaceous vegetation of the other treatments competes with the elm seedlings to the point of limiting or reducing their stand density.

The results of this study indicate that natural recovery of desirable grasses following brush control on this vegetative type is a slow process. This is especially true where so little in the way of desirable species is present at the time of treatment. Reseeding offers an opportunity to speed up the establishment of forage species but more research is needed to find a successful and economical reseeding technique that can be used with chemical control of elm and oak.

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Aerial Application of Herbicides for Control of Sand Sagebrush[1]

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Highlight

Single aerial applications of 2,4-D; 2,4,5-T; and a 1:1 mixture of the two gave excellent control of sand sagebrush at some locations in western Nebraska. Repeat applications were necessary for best results to kill regrowth the following year. Silvex consistently gave excellent control from a single application.

Sand sagebrush (*Artemisia filifolia* Torr.) is a woody shrub, 30 to 150 cm. tall with freely branching stems occurring on dry plains of Nebraska, Wyoming, and south to Mexico. Klingman (1962) indicated the total acreage infested by this shrub in the continental United States is estimated at 96 million acres. Shafer (1955) reported at least 100,000 acres in western Nebraska almost useless for grazing because of sand sagebrush (Figure 1). McIlvain et al. (1955) conducted extensive control experiments of the species in Oklahoma, showing that one proper application of 2,4-D can kill three-fourths of the sagebrush on infested lands. Subsequent forage and beef production can be increased from 50 to 75 percent. The most effective spray solution was 1 lb/A of the ester form of 2,4-D in three gallons per acre (gpa) diesel oil or a 2:1 water: oil emulsion.

Shafer (1951) conducted preliminary aerial application control studies on sand sagebrush in 1949, at Benkelman, Nebraska. Treatment with 2,4-D for two consecutive years gave best results. Average percentage kill one year after a single application was 60 percent as compared to 96 percent one year after two consecutive years of treatment. Diesel oil was considered the most effective carrier. Optimum treatment time of sand sagebrush usually occurs during June depending on the amount and rate of new growth.

The studies reported here were conducted to determine the most economical and effective herbicide and/or herbicides, carriers and spray volumes for sand sagebrush control by aircraft.

FIGURE 1. *Top*—Dense stand of sand sagebrush near Haigler, Nebraska. Forage production is greatly reduced. Aircraft applications of herbicides are ideal for such large acreages. *Bottom*—Area at Alliance, Nebraska, aerially treated June, 1961 and 1962, with one lb./A 2,4-D in No. 2 diesel oil at 5 gpa. Ungrazed luxuriant growth of needle and thread released by removal of sand sagebrush. Photograph June, 1963.

Materials and Methods

Sand sagebrush control studies were initiated in 1960 at Alliance and Haigler, Nebraska, on a Val-

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entine fine sandy loam and a Dundy loamy fine sand, respectively. The mean annual temperature is 48.2°F. with an annual precipitation of 15.0 inches at Alliance. At Haigler the mean annual temperature is 53.8° F. with a yearly precipitation of 16.2 inches. The majority of the precipitation occurs in the spring and summer months at both locations. The predominant native grass at the Alliance location is needle and thread *(Stipa comata* Trin. & Rupr.). At the Haigler site the main native grasses are as follows in order of predominance: blue grama *(Bouteloua gracilis* (H. B. K.) Lag.), prairie sandreed grass *(Calamovilfa longifolia* (Hook) Scribn.) and little bluestem *(Andropogon scoparius* Michx.).

Aerial application equipment consisted of a Piper Super Cub with a modified spray dispersal system. Spray booms were relocated to give uniform spray coverage and drift control. A total of 37 Whirljet type nozzles were placed at desired locations on the streamlined boom. Constant output by the spray solution pump was accomplished by a hydraulic drive system (Shafer, 1960).

Herbicide treatments were made when sand sagebrush had attained 6 to 10 inches of new growth. The herbicides used were the propylene glycol butyl ether (PGBE) esters of 2,4-D, 2, 4, 5-T, 2-(2, 4, 5-trichlorophenoxy) propionic acid (silvex) and a 1:1 mixture of 2,4-D and 2,4,5-T.

In the first experiment, aerial spray applications were made on June 17, 1960, at Alliance, and June 24, 1960, at Haigler. At Alliance, the 2,4-D treatments were applied at ½, 1, and 2 lb/A. The 2,4,5-T, 2,4-D and 2,4,5-T mixture and silvex were applied at 2 lb/A. At Haigler, 2,4-D was applied at ½, 1, and 2 lb/A, 2,4,5-T at ½, 1, and 2 lb/A, and the 2,4-D and 2,4,5-T mixture at 2 lb/A. Repeat applications were made on June 20, 1961, at Alliance, and June 21, 1961, at Haigler. Retreatment consisted of original herbicides and rates as applied in 1960 superimposed on ½ of the original plots. Therefore, the retreated plots were 99 by 220 feet in area.

Leaf kill was determined three months after treatment on thirty plants randomly selected in each plot. Control ratings were made on the basis of 0 to 10, with from no leaf kill to complete kill. These values were converted to percentages. Regrowth was determined by evaluating 30 plants at random in each plot during June, one, two, and three years after initial herbicide applications. Percentage regrowth, as used in this paper, is the reciprocal of percentage kill. Each plant evaluated was considered alive if any regrowth was present and dead if regrowth was absent. Visual estimates of control, based on total top kill (leaf and stem) were made in June, 1963, at the conclusion of the experiment to supplement other counts.

Additional experiments were established on June 20, 1961, at Alliance and June 18, 1962, at Haigler to study the effects of herbicide carriers and spray volumes on sand sagebrush control.

Number 2 diesel fuel, water, and water plus a surfactant (Multifilm X-77) were the three carriers used. Spray volumes consisted of 2 and 5 gallons per acre. One lb/A of the PGBE esters of 2,4-D was used with all carrier-spray volume combinations. Each plot was two flight strips wide, each strip being 33 feet wide and 330 feet long. Each treatment was replicated. Percentage regrowth of sand sagebrush was determined by randomly selecting 20 plants in each plot and designating as dead or alive one year after the initial treatment and one year after retreatment. Repeat applications were made at Alliance in mid-June, 1962, superimposing identical treatments on the original plots after kill evaluations were made. Retreatments were not made on the Haigler site. Evaluations were also determined by visual estimation of top kill in June, 1963.

Aerial control of sand sagebrush was also studied on a dunesand soil at Angora, Nebraska, near Alliance. Two experiments at this location were conducted primarily for the control of Yucca *(Yucca glauca* Nutt.) but sand sagebrush occurred on all plots. Studies initiated on June 17, 1960, consisted of one acre plots with retreatment of one-half the original plot on June 20, 1961. One, two and four lb/A of silvex was applied. On June 19, 1961, a carrier-spray volume study was initiated for Yucca control. The treatments consisted of diesel fuel, water alone, and water plus surfactant. Silvex at 2 lb/A was applied in combination with each carrier at spray volumes of 2 and 5 gpa. Repeat applications were made on June 18, 1962. Percentage regrowth was determined by counting all sand sagebrush plants in each plot and designating as dead or alive. Control evaluations were made three months, one, two, and three years after original application in the case of the study initiated in 1960, and one and two years in the 1961 study.

Results and Discussion

Excellent top kill can be obtained with a single application of 2,4-D, 2,4,5-T or silvex. However, regrowth may occur the year after a single application. The amount of regrowth depends on time of application, stage of growth, environmental conditions, herbicides and dosage. The time of application was considered optimum in these studies since they were made when there was adequate soil moisture. Plants were in full leaf and growing rapidly.

In the first experiment, considerable regrowth took place the year following initial application at the Alliance and Haigler locations (Table 1 top). In general, top kill of sand sagebrush was better at Haigler three months after treatment than at Alliance. However, the amount of regrowth at Haigler was much greater one year after a single application. Two years after single application, increase in regrowth at Alliance was considerable in all but the 2,4,5-T and silvex plots while at Haigler, 2,4-D at 1 lb/A, the 1:1 mixture of 2,4-D and 2,4,5-T at 1 lb/A each and 2,4,5-T at 1 lb/ showed a decrease in regrowth. Percentage regrowth did not markedly change from two to three years after a single application of chemical at either location.

Table 1. Initial leaf kill and subsequent regrowth of sand sagebrush after single and repeat applications of PGBE ester formulations of 2,4-D, 2,4,5-T, 2,4-D plus 2,4,5-T and silvex in diesel oil at 5 gpa.

Location and herbicide	Rate	Time after application: Single — Leaf kill 3 mo.	Single — Regrowth[1] 1 yr.	Single — Regrowth[1] 2 yr.	Single — Regrowth[1] 3 yr.	Repeat — Regrowth 1 yr.	Repeat — Regrowth 2 yr.
	(Lb/A)	(Percent)					
Alliance							
2,4-D	½	57	45	80	83	17	50
2,4-D	1	86	35	70	50	13	7
2,4-D	2	96	25	60	60	7	3
2,4-D + 2,4,5-T	1 + 1	97	20	63	40	3	0
2,5,5-T	2	98	40	53	60	0	0
Silvex	2	99	22	20	23	7	3
Haigler							
2,4-D	½	90	72	73	43	10[2]	0
2,4-D	1	100	57	23	27	0	0
2,4-D	2	100	55	60	50	0	0
2,4-D + 2,4,5-T	1 + 1	100	67	57	33	0	0
2,4,5-T	½	100	62	67	80	0	0
2,4,5-T	1	100	57	53	60	0	0
2,4,5-T	2	100	52	70	70	0	0

[1] Percentage kill is the inverse of percentage regrowth; it can be derived by subtracting percentage regrowth from 100.
[2] The ½ lb/A 2,4-D treatment at Haigler was retreated with 1 lb/A.

Evaluations one year after initial treatment indicated retreatment was necessary for best control of sand sagebrush (Table 1). At Alliance one-half lb/A of 2,4-D showed 17 and 50 percent regrowth for one and two years, respectively, after repeat applications. The remaining treatments showed less regrowth. At Haigler, there was no regrowth of sand sagebrush two years after repeat applications with any of the chemicals. Table 2 gives final evaluations of the control for single and repeat treatments. Single herbicide treatments at Haigler gave better control than at Alliance. Excellent control was obtained with repeat applications of all herbicides at Alliance and Haigler except ½ lb/A of 2,4-D at Alliance. One lb/A of 2,4-D applied two consecutive years at Alliance and Haigler gave 95 and 100 percent control, respectively.

The proper spray volume per acre for effective woody plant control by aerial application has not been fully explored. The volume depends upon several factors, including the method of herbicide application, species, and density of the vegetation. Darrow (1956) stated that volume spray rates for brush control by aircraft are commonly four to five gallons per acre. Hansen (1952) reported that as a general rule, low volume-high concentration treatments of phenoxy chemicals have been considerably less effective than the high volume-low concentration. However, aerial applications using five gallons or less per acre of a concentrated solution have been effective in most situations.

In this study, there were no significant differences between 2 and 5 gpa spray volumes at Alliance and Haigler when used in combination with 1 lb/A 2,4-D for control of sand sagebrush (Table 3). Also, there were no differences in number 2 diesel fuel, water, or water plus surfactant carrires in combination with 1 lb/A 2,4-D. The regrowth after repeat application was substantially higher at Alliance

Table 2. Sand sagebrush control based on top kill 3 years after original aerial application on plots with single and repeat treatments of PGBE ester of 2,4-D, 2,4,5-T, 2,4-D plus 2,4,5-T, and silvex in diesel oil at 5 gpa.

Location and herbicide	Lb/A	Treatment: Single	Treatment: Repeat
		(Percent)	
Alliance			
2,4-D	½	50	70
2,4-D	1	60	95
2,4-D	2	70	99
2,4-D + 2,4,5-T	1 + 1	70	100
2,4,5-T	2	70	100
Silvex	2	90	100
Haigler			
2,4-D	½	90	100
2,4-D	1	90	100
2,4-D	2	90	100
2,4-D + 2,4,5-T	1 + 1	90	100
2,4,5-T	½	85	100
2,4,5-T	1	85	100
2,4,5-T	2	85	100

Table 3. Regrowth and top kill of sand sagebrush one year after single and repeat applications of 1 lb/A 2,4-D in diesel oil, water, and water plus surfactant at spray volumes of 2 and 5 gpa.

Location, herbicide, and carrier	Regrowth: Single	Regrowth: Repeat	Top kill: Single	Top kill: Repeat
	(Percent)			
Alliance				
2,4-D + water + surfactant at 2 gpa	52	42	....	85
2,4-D + water + surfactant at 2 gpa	52	35	....	88
2,4-D + No. 2 diesel oil at 2 gpa	57	35	....	88
2,4-D + water at 5 gpa	62	35	....	85
2,4-D + water + surfactant at 5 gpa	60	40	....	90
2,4-D + No. 2 diesel oil at 5 gpa	45	35	....	93
Haigler				
2,4-D + water at 2 gpa	67	....	93	....
2,4-D + water + surfactant at 2 gpa	57	....	95	....
2,4-D + No. 2 diesel oil at 2 gpa	52	....	93	....
2,4-D + water at 5 gpa	42	....	95	....
2,4-D + water + surfactant at 5 gpa	60	....	90	....
2,4-D + No. 2 diesel oil at 5 gpa	47	....	93	....

than in other years. Close examination revealed that regrowth in the treated plots was very small in proportion to total plant material, although the total number of plants showing regrowth might be high. It is questionable whether many of these plants will survive. The plants that do survive will require several years to regain competitive vigor against desirable forage species (Figure 1, bottom). Estimated control based on top kill of sand sagebrush at Alliance and Haigler is given in Table 3. A single application at Haigler gave as good or better control than the repeat treatment at Alliance.

Excellent control of sand sagebrush was obtained in a study in which silvex was applied by airplane (Table 4). A single application of 1 lb/A silvex was the only treatment showing any regrowth two years later. A single application of 2 lb/A silvex appeared to be very effective. No differences were noted in control due to herbicide carrier or spray volume.

Table 4. Initial leaf kill and subsequent regrowth of sand sagebrush after single and repeat applications of silvex at Angora, Nebraska.

Year applied, herbicide, and carrier	Lb/A	Time after application: Single — Leaf kill 3 mo.	Single — Regrowth 1 yr.	Single — Regrowth 2 yr.	Single — Regrowth 3 yr.	Repeat — Regrowth 1 yr.	Repeat — Regrowth 2 yr.
1960		— — — (Percent) — — —					
Silvex + No. 2 diesel oil at 5 gpa	1	100	0	1	22	0	10
Silvex + No. 2 diesel oil at 5 gpa	2	100	0	0	0	0	0
Silvex + No. 2 diesel oil at 5 gpa	4	100	0	0	0	0	0
1961							
Silvex + water at 2 gpa	2	.....	5	..	....	..	....
Silvex + water + surfactant at 2 gpa	2	.....	5	..	....	0	....
Silvex + No. 2 diesel oil at 2 gpa	2	.....	5	..	....	0	....
Silvex + water at 5 gpa	2	.....	5	..	....	0	....
Silvex + water + surfactant at 5 gpa	2	.....	5	..	....	0	....
Silvex + No. 2 diesel oil at 5 gpa	2	.....	5	..	....	0	....

Summary and Conclusions

Single and repeat aerial applications of 2,4-D; 2,4,5-T; a 1:1 mixture of 2,4-D and 2,4,5-T; and silvex were applied for sand sagebrush control in western Nebraska. Single applications of the phenoxy herbicides gave excellent control at some locations. Repeat applications were necessary for best results to kill regrowth the year following initial treatment with 2,4-D and/or 2,4,5-T. Silvex consistently gave excellent control from a single application at the rates used.

One lb/A 2,4-D and 2 lb/A silvex were applied in combination with number 2 diesel fuel, water, and water plus surfactant carriers. Two and 5 gpa spray volumes were used with all carrier combinations. Results indicate there were no differences in sand sagebrush control due to carriers or spray volume.

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The Relation of Grazing to Plant Succession in the Tall Grass Prairie

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Highlight

Grassland plots were subject to moderate grazing until 1949, but half of the plots were protected after that time. In general, complete protection from grazing resulted in rapid plant succession, an improvement in vegetation composition, a decrease in forage, and an increase in fresh and humic mulch.

The harmful effects of heavy grazing have been enumerated by many investigators, especially J. E. Weaver and his associates. These detrimental effects include changes in composition, an increase in weeds and a decrease in forage, mulch and the rate of succession. Heavy grazing may also result in poorer physical structure of the soil, decreased fertility and an increase in bare soil, runoff and erosion.

Some harmful effects of light grazing and no grazing have been reported. According to Weaver and Fitzpatrick (1934), the accumulation of excessive mulch retarded growth in the spring and probably eliminated many seedlings. As early as 1948, Tomanek observed that "The highest seasonal yield of short grass . . . was produced in the moderately grazed pasture, fol-

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lowed . . . by the undergrazed, overgrazed and heavily grazed locations." In a study of the prairie vegetation of an abandoned, revegetating roadway near Lincoln, Nebraska, Weaver and Rowland (1952) observed that growth and flowering were delayed and yields were lower in the abandoned roadway than in the grazed prairie. In the area of our study, Kelting (1954) observed that a protected prairie possessed fewer species, and less living cover and forage than the grazed prairie. In the soil of the protected prairie the volume-weight values and the amount of organic carbon were lower than in the grazed prairie.

Smith (1940b) referred to the tall grass prairie in the area of study as a mixed prairie with little bluestem[2] and sideoats grama as the dominants. No mention was made of the other tall grass species that are now dominant. Since his studies were made in the late thirties, near the end of the extended drought, it seems possible that recovery of the prairie had proceeded only to the midgrass stage.

Several investigators have delineated the stages of succession in revegetating cropland in the tall grass prairie area (Booth, 1941; Kelting, 1954; Smith, 1940a and Weaver, 1954). Among workers who have reported on plant succession in forested areas are Drew (1942) and Quarterman (1957). The reports of these investigators suggest that both drought and grazing decrease the rate of plant succession.

Description of Plots

The study plots are located in the Grassland Investigations Project, about ten miles southwest of Norman, in McClain County, Oklahoma. The four plots (units) utilized were designated as protected prairie (2 acres), grazed prairie (ca. 20 acres), protected cropland (5 acres) and grazed cropland (ca. 3 acres). These plots were situated on a sandy loam soil with a gentle, north-facing slope. The cropland units were planted to Korean clover in 1941, and allowed to revert to natural conditions. At the time of fencing, in 1949, all prairie and cropland plots had been subjected to moderate, longtime grazing. The protected units were ungrazed and all units were unburned since 1949. At the Oklahoma City Airport, about 12 miles north of the plots the average annual precipitation is 30.82 inches (Weather Bureau, 1963). During the period of study, however, the precipitation varied from 17.84 inches in 1954 to 46.46 inches in 1959.

In the autumn of 1950, after the first growing season of protection, little bluestem was the major dominant in the tall grass prairie. At this time there were few differences in composition between the protected and the grazed prairies. At the end of the first growing season (1950) the dominants in the protected cropland were prairie threeawn and Korean clover (Penfound and Rice, 1957). As was true for the prairie plots there were only minor differences between the composition of the protected cropland and that of the grazed cropland just beyond the fence.

Methods

The protected prairie and protected cropland plots were sampled more often than their contrasting grazed units, although all plots were sampled in 1959 and 1962. In all four plots, the autumnal composition was determined by means of 25 quadrats of 0.1 square meter each. From the field data, frequency and cover were calculated, but only relative foliage cover data are presented herein. In 1959, standard errors were calculated for actual foliage cover, and were found to average about 25 percent of the means. In comparing relative foliage cover in Tables 1 and 2, it is probable that, except for the dominants, the means are not significantly different unless they vary by 100 percent or more.

Results and Discussion

The total number of species sampled in the quadrats was somewhat lower in the protected prairie than in the grazed. (Table 1). This was due, undoubtedly to the heavy mulch cover in the protected prairie. There was, however, no diversity in the number of species in the protected and grazed cropland units during the same growing season, although there were differences in composition (Table 2).

In the protected prairie, the total percentage foliage cover did not differ significantly at the three sampling dates. The relative cover in the protected cropland, however, was very high in 1950, very low in 1954 and moderate in 1959 and 1962. In the protected cropland in 1950, it is probable that the high relative cover can be explained by the low spreading nature of prairie threeawn and especially of Korean clover which furnished most of the cover. The very low cover in both the protected prairie and protected cropland in 1954 was due, undoubtedly, to the poor growing conditions in that season (Table 3). Rainfall was deficient throughout the summer and very high temperatures prevailed during July (+5.3°F) and August (+3.9°F). Only slight differences in average foliage cover occurred between 1959 and 1962. Presumably, the growing season in 1959 was somewhat more favorable than in 1962 but the data do not indicate it.

Little bluestem was the major dominant in the tall grass prairie at the start of the study (Figure 1). In 1954, this species continued as the important domi-

[2] *Scientific names of all species are listed in Tables 1 and 2. Nomenclature according to Waterfall, 1952.*

nant (Table 1). By 1959, little bluestem had declined considerably and two of the other prairie dominants had shown a notable increase in relative cover (Table 1, Figure 2, left). The reason for the very high relative cover of big bluestem is not clear, although considerable annual fluctuation in this species had been noted in the past. By 1962, sideoats grama, coralberry, and three of the prairie dominants contributed most of the cover (Table 1, Figure 2, right). The high relative cover of sideoats was surprising, especially since the cover was high also in the grazed prairie during the same year. It seems probable that there are many such annual fluctuations in the prairie, which are probably related to unknown combinations of climatic factors.

Table 1. Relative foliage cover in prairie plots. Species arranged in order of appearance in succession from bottom upward.

Common name	Scientific name	Protected prairie			Grazed prairie	
		1954	1959	1962	1959	1962
Coralberry	*Symphoricarpos orbiculatus*		2.6	15.0	0.2	0.8
Switchgrass	*Panicum virgatum*	7.4	17.2	22.0	4.6	2.7
Big bluestem	*Andropogon gerardi*	0.4	28.4	11.0	1.2	4.6
Indiangrass	*Sorghastrum nutans*	7.0	9.6	8.7	4.5	6.9
Little bluestem	*Andropogon scoparius*	60.8	29.0	20.4	25.7	30.5
Heath aster	*Aster ericoides*	6.8	0.9	0.1	0.8	2.4
Sideoats grama	*Bouteloua curtipendula*	0.4	2.2	11.4	1.5	18.5
Fall witchgrass	*Leptoloma cognatum*	2.7	4.4	2.6	10.2	5.8
Scribner panicum	*Panicum scribnerianum*	2.0	1.0	1.0	7.5	3.6
Hairy Paspalum	*Paspalum pubescens*			0.1	9.7	1.4
Western ragweed	*Ambrosia psilostachya*	4.3			27.1	17.2
Other species		8.2	4.7	7.7	7.0	5.6
Number of species		26	21	19	31	29
Total % cover		30.7	35.5	42.2	52.1	47.3

Table 2. Relative foliage cover in protected cropland and grazed cropland. Species arranged in order of appearance in succession from bottom upward.

Common name	Scientific name	Protected				Grazed	
		1950	1954	1959	1962	1959	1962
Indiangrass	*Sorghastrum nutans*			0.3	16.5	0.4	0.3
Little bluestem	*Andropogon scoparius*	0.1	2.4	38.0	52.6	44.9	65.1
Fall witchgrass	*Leptoloma cognatum*	7.7	22.7	13.8	6.0	5.9	1.3
Scribner panicum	*Panicum scribnerianum*	13.4	27.9	32.9	14.0	10.4	3.5
Silver bluestem	*Andropogon saccharoides*		0.4	0.9	0.4	13.2	8.4
Heath aster	*Aster ericoides*	0.5	14.6	1.0	2.3	3.1	3.1
Western ragweed	*Ambrosia psilostachya*	0.8	15.0	1.0	1.1	8.3	6.4
Korean clover	*Lespedeza stipulacea*	25.5	0.1			3.0	3.3
Prairie threeawn	*Aristida oligantha*	50.1	5.3			3.9	2.3
Other species		1.9	12.7	12.1	7.1	6.9	6.3
Number of species		28	22	31	27	30	27
Total % cover		74.4	24.7	42.4	38.0	61.3	35.2

The most important aspect of plant succession in the protected prairie since 1954 was the notable invasion of woody species (Figure 2, right). This has involved a great increase of native woody species of the prairie, especially of coralberry. In addition, several typical forest shrubs and trees have invaded. At present, eighteen different woody species have been found in the protected prairie. If this invasion continues at the present rate, it is probable that the prairie will have been eliminated by 1980.

The major dominant in the grazed prairie in 1950 was little bluestem. In 1959, the dominants in the grazed prairie comprised one midgrass (little bluestem) and one forb (western ragweed). By 1962, dominance was shared by little bluestem, western ragweed and sideoats grama. The other three prairie dominants and coralberry were present in the grazed prairie but not dominant (Table 1).

FIGURE 1. The grazed prairie is characterized by the uneven nature of the stand and the dominance of *Andropogon scoparius*.

Table 3. Average temperature and precipitation of growing season April through October, based on average monthly data of Weather Bureau at Oklahoma City.

Datum	Year			
	1950	1954	1959	1962
Average monthly temp.	70.5	74.7	70.4	72.7
Departure from normal	− 0.70	+ 2.21	− 2.01	+ 1.20
Average monthly precip.	3.82	2.09	5.70	3.16
Departure from normal	+ 0.47	− 1.06	+ 2.54	− 0.15

The major dominants in the protected cropland at the start of the study were prairie threeawn and Korean clover (Table 2). By 1954, these species had been replaced by two forbs (western ragweed and heath aster) and two short grasses (Scribner panicum and fall witchgrass). Both forbs, however, exhibited very low relative cover in the previous (1950) and subsequent sampling periods (1959, 1962). This is another case where species suddenly attained prominence and later reverted to insignificance without apparent cause. By 1959, the midgrass (little bluestem) and two short grasses (Scribner panicum and fall witchgrass) were the important species in the protected cropland (Table 2). During the next three years, two of the prairie dominants: little bluestem and indiangrass increased in relative cover, primarily at the expense of the short grasses.

Prairie threeawn and Korean clover were the dominants in the grazed cropland in 1950. By 1959, these species were replaced largely by little bluestem, silver bluestem and Scribner panicum. This was the only plot and period where this midgrass (silver bluesteam) was important. By 1962, however, it had declined somewhat and little bluestem had become the sole dominant.

Apparently the effects of undergrazing, and of no grazing, are due to prodigious mulch. Much of this mulch lies flat on the ground and is of sufficient thickness to prevent the emergence of seedlings and culms of the dominant grasses. The open (dead) spaces that are produced allow the ecesis of annual forbs and the seedlings of woody plants. In the study of a protected prairie in an abandoned roadway northwest of Lincoln, Nebraska, no invasion of woody species was reported by Weaver and Rowland (1952). In southwestern South Dakota, the virgin grassland, long protected from fire and grazing, did not accumulate sufficient mulch to prevent the continuing dominance of grass (Larson and Whitman, 1942). It seems probable, therefore, that the establishment of trees, even in areas completely protected from fire and grazing, is unlikely when the annual precipitation is much less than 20 inches.

The rate of succession is related to the amount of grazing. Overgrazing causes retrogression, moderate grazing decelerates the rate of succession whereas light grazing and complete protection accelerate the successional process. During the 13 years of the study, the major dominant of the grazed prairie remained the same, presumably because the community had reached stability under the practiced grazing regime. In the grazed cropland the composition changed from an annual grass stage through a short grass-midgrass status to a midgrass type, essentially the same as in the grazed prairie.

In the protected prairie, the vegetation changed from midgrass to midgrass-tall grass to midgrass-tall grass-woody plants in 13 years. Booth (1941) reported that, under favorable conditions, the oldest field with bunch grass was 30 years of age but ". . . did not appear to be

FIGURE 2. *Left:* After seven years of protection, the formerly grazed prairie exhibited a very even grass cover of typical tall grass prairie dominants. *Right:* After thirteen years of protection, the formerly grazed prairie had been invaded by many woody species. Present grazed prairie in background.

nearing the fully-developed prairie stage." In the current investigation, however, the succession had proceeded past the prairie stage to incipient woodland in 13 years. It appears that elm and hackberry may be the most important tree dominants as was the case in central Tennessee (Quarterman, 1957). In the protected cropland the succession proceeded through the following stages in the 13-year period: annual grass to forb-short grass to short grass-midgrass to short grass-midgrass-tall grass. These facts suggest that plant succession in tall grass prairie is much more rapid than is usually reported.

As indicated previously, there were several examples in our investigation in which a given species, which had been uncommon, suddenly attained important status in a given growing season, only to return to an insignificant role in the following year. In the prairie plots this was true for big bluestem, hairy paspalum and sideoats grama. In the cropland plots, this phenomenon was exhibited by western ragweed and heath aster. Dr. G. J. Goodman (personal correspondence) has observed this 'pulse phenomenon' in six native species at the University of Oklahoma Biological Sation on Lake Texoma. I have observed this same phenomenon in the marsh fleabane, *Pluchea purpurascens*, along the Lake Texoma shoreline. This species was a predominant plant in 1959 but was present only sporadically in 1958 and 1960.

Summary

The effects of complete protection from grazing upon plant composition and plant succession in tall grass prairie and revegetating cropland are reported herein. These grassland plots, located about ten miles southwest of Norman, Oklahoma, have been protected from grazing since 1949. They were designated as follows: protected prairie, grazed prairie, protected cropland and grazed cropland. In all plots, autumnal composition was determined by means of 25 quadrats of 0.1 sq. m. each.

In the protected prairie, the vegetation changed from midgrass (1950) through representative tall grass prairie (1959) to tall grass prairie with many woody species (1962). If protection continues, it seems probable that much of the protected prairie will be taken over by woody plants. In the grazed prairie the vegetation remained nearly constant since the midgrass (little bluestem) was the major dominant throughout.

In the protected cropland the vegetation changed rapidly through the following stages: annual (1950), forb-short grass (1954) to short grass-midgrass-tall grass (1962). In the grazed cropland the plant population shifted from annual grass (1950) through short grass-midgrass (1959) to a midgrass type (1962).

The most important species in all four tracts was the little bluestem. Considerable plant succession occurred in all plots but was much more rapid in the protected units.

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REMINDER

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Sixweeks Fescue As A Deterrent To Blue Grama Utilization[1]

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Highlight

Sixweeks fescue was found unacceptable to cattle at all seasons and nitrogen fertilization did not increase its rooting strength or palatability. It contributed nothing to forage supply and interfered with cattle grazing of blue grama. Alternative practices for alleviating irregular grazing distribution include weed control or fertilization of infested areas to attract cattle.

Sixweeks fescue *(Festuca octoflora* Walt.) hinders the utilization of blue grama *(Bouteloua gracilis* (H.B.K.) Lag. ex Steud.) because cattle prefer areas most free of this annual grass. Hylton and Bement (1961) estimated a loss of about $25 per head in 1958 when yearlings failed to graze infested upland areas. This is a loss of $2 to $3 per acre based on the areas needing treatment.

Sixweeks fescue is scattered over Colorado at altitudes of 3500 to 8500 feet, and, in several varietal forms, is found throughout the United States (Harrington, 1954). On the Central Great Plains it is prevalent about once or twice in ten years, but its intermittently high abundance on some sites seriously disrupts management practices and reduces cattle gains. Consequently, ranchers requested consideration of the problems associated with this weed. Klipple and Costello (1960) reported sharp year to year fluctuations in fescue density under all grazing intensities. These stand fluctuations are related to weather and probably to soil and grazing differences. The seeds germinate in late summer or fall if high precipitation and cool temperatures prevail (Hylton and Bement, 1961).

Summer grazing extends from May 1 to November 1 on the Central Plains Experimental Range. Restricted grazing distribution becomes apparent in mid-season when the fescue matures and turns brown, but the seasonal nature of cattle rejection of infested areas is obscure. Headed plants are pulled easily with a ball of soil attached. Since cattle pull and drop many plants in the summer and fall, the attached soil is an obvious cause of cattle rejection. Odor, taste, and/or texture also are suspected as causes of rejection because the cattle refrain from grazing blue grama where sixweeks fescue is abundant.

Several possible solutions need consideration. One might limit grazing to a specific season when sixweeks fescue is not objectionable to cattle, fertilize for stronger rooting and higher palatability of sixweeks fescue, control occurrences by proper grazing, or treat with an herbicide for chemical control. The best approach cannot be determined until the problem is better understood.

Consequently, this paper evaluates sixweeks fescue as a deterrent to the utilization of blue grama range. New information is given on the ecological occurrence of sixweeks fescue by range sites, the effect of grazing intensity on fescue abundance, the seasonal extent of cattle rejection, and the effect of nitrogen fertilization and selective-herbicide treatment on cattle preferences. A promising approach to problem alleviation is suggested.

Methods

An area of Ascalon sandy loam on the "plains upland" range site where cool temperatures and precipitation of 2.64 inches in September promoted the establishment of a thick stand of sixweeks fescue was selected in early October, 1961. A 3 by 6 strip-plot experiment was established in 3 replications including 3 cultural treatments and 6 grazing times. The cultural treatments were untreated check, ammonium nitrate at 40 lb N/A applied surface broadcast in October, 1961, and simazine (2-chloro-4, 6-bis-(ethylamine)-S-triazine) at 3.5 lb/A active ingredient applied as a broadcast spray in October, 1961. Grazing times were May 10, May 25, June 7, June 27, August 2, and September 12, 1962. Cultural treatments were applied on plots 50 feet wide by 600 feet long east-west, and were randomized in a latin-square arrangement among replications. Grazing times were assigned randomly to plots 100 feet wide by 150 feet long north-south. Plots were isolated by electric cross fences to control grazing animals.

Yearling Hereford heifers were penned off feed on water overnight prior to experimental grazing. Three heifers were admitted in each replication at the first grazing time and six were admitted at other times. This number of animals accomplished moderate to heavy grazing on the most-preferred plot in 3 hours (approximately 9 a.m. to 12 noon). The heifers actually grazing were counted at 5-minute intervals. Since they were

[1] *A contribution of the Central Plains Experimental Range, Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, and Colorado Agricultural Experiment Station, Colorado State University, Fort Collins. Published with the approval of the Director, Colorado Agricultural Experiment Station, as Scientific Series Paper No. 944.*

free to move back and forth among untreated, fertilized, and simazine-treated plots, the accumulated grazing observations evaluated cattle preferences among plots (Peterson, et al., 1958).

Species frequencies were sampled with an 8 by 8-inch quadrat prior to grazing. The plots grazed on date 5 were sampled for herbage yields. Ten 1 by 2-foot areas were hand clipped at ground level on each treatment plot on July 5, 1962. The herbage was weighed air dry to estimate yields.

Residual effects of cultural treatments were evaluated on June 18, July 9, and August 9, 1963.

To study fescue occurrence by range sites and grazing intensities, macroplots 100 by 75 feet were located on 53 different areas representing different range sites and different grazing intensities. Each macroplot was sampled in 1962 with 250 quadrats measuring 16 by 16 inches for the frequency of sixweeks fescue. Weather conditions were unsatisfactory for the establishment of sixweeks fescue in the fall, 1962, and the macroplots were not resampled in 1963.

Results

Species Composition on Treated Plots.—The frequencies of perennial species were equal among treatments, but nitrogen increased the frequencies of annual herbs and simazine nearly eliminated them (Table 1). Sixweeks fescue was the most frequent annual.

Plant Phenology and Growth.—Sixweeks fescue was drying up from lack of moisture on May 10, 1962, and there was very little new growth of other species. Abundant rainfall in mid-May (2.86 inches from May 17 to 28) restored the sixweeks fescue, promoted the emergence of other annuals, and initiated blue grama growth. On May 25, the fescue was heading out about 1 to 3 inches tall on untreated plots and 2 to 5 inches on nitrogen plots. Nitrogen and simazine had not affected the height of blue grama, but there had been a little color change on fertilized plots. New growth was abundant on June 7, and blue grama herbage on fertilized plots appeared taller and darker green than on other plots.

The appearance of fertilized plots was even more obvious on June 18, and simazine effects had appeared in nearly all species. Most of the annuals on simazine plots were dead. Scarlet globemallow *(Sphaeralcea coccinea* (Pursh) Rydb.) was turning yellow from simazine effects—but blue grama was stimulated to produce longer leaves which appeared darker green than on untreated plots when viewed facing the sun and lighter green when facing away from the sun.

Sixweeks fescue was dry with seed shattering and blue grama was in anthesis on July 5. The sixweeks fescue matured at about 5 inches tall on fertilized plots and about 3 inches on untreated ones.

Blue grama culms and heads obscured other vegetation by August 2 (especially on treated plots) and the dry sixweeks fescue was not readily apparent.

The herbage was all dry and brown by September 12, except that blue grama retained some green color near the soil on simazine-treated plots.

The sixweeks fescue pulled easily, and with soil attached, at all seasons. Nitrogen fertilization did not increase rooting strength.

Cattle Preferences.—Both nitrogen and simazine increased cattle preferences for the herbage produced (Figure 1). Averaged over all times and expressed in percent of total observations, the heifers preferred untreated, nitrogen, and simazine plots in the

Table 1. Species frequencies in 8 by 8-inch quadrats by treatments.

Species[1]	Untreated check	Nitrogen	Simazine
		(Percent)	
PERENNIALS:			
Blue grama	97±3[2]	98±1	98±1
Broad-leafed sedge	14±6	21±13	16±6
Plains pricklypear	11±4	10±3	10±4
Scarlet globemallow	8±1	6±2	8±3
Three-awn	6±6	2±1	2±3
Sand dropseed	3±4	1	1
ANNUALS:			
Sixweeks fescue	88±5	94±3	5±3
Cryptantha	5±2	13±4	1
Russian thistle	2±2	5±3	0

[1]Thirty-four species with frequencies of 2% or less were omitted. Nomenclature follows Harrington (1954): Broad-leafed sedge *(Carex heliophila* Mack.), plains pricklypear *(Opuntia polyacantha* Haw.), three-awn *(Aristida longiseta* Steud.), sand dropseed *(Sporobolus cryptandrus* (Torr.) A. Gray), cryptantha (*Cryptantha minima* Rydb.) and Russian thistle *(Salsola kali* L.).

[2]Means were computed from 1500 quadrat placements, and the data were treated as a normal distribution with 15 observations in the computation of confidence limits at the .05 probability level.

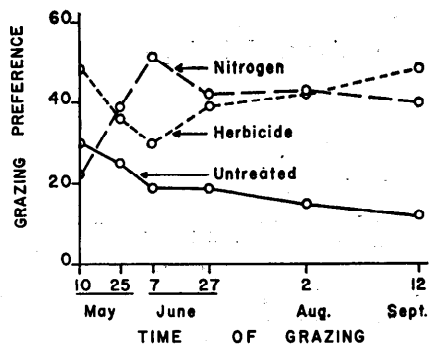

FIGURE 1. Seasonal grazing preferences (percent of total observations) among untreated, nitrogen, and simazine plots (L.S.D. at .01 = 15%).

proportions 20, 40, and 40%, respectively (L.S.D. at .01 = 11%). However, there were significant seasonal differences in the preferences expressed among treatments. Preferences for untreated plots declined as the season progressed, indicating a seasonal increase in the relative importance of the treatments. On May 10 the heifers preferred simazine-treated plots over untreated and untreated over fertilized ones. These preferences were negatively related to the frequency of occurrence of sixweeks fescue, which was only ¼ to ½ inch tall.

Nitrogen fertilization imparted a little darker color to the herbage by May 25, when these plots were preferred as much as simazine-treated ones.

The blue grama on fertilized plots was much darker and taller by June 7, and the heifers preferred this herbage over that on simazine and untreated plots. The heifers grazed avidly on fertilized plots, but with a quick swing of the tongue, felt the herbage before each bite. Clumps of sixweeks fescue touched by the tongue were rejected by a quick side movement of the muzzle. Small fescue plants growing in blue grama clumps sometimes were pulled and eaten along with the blue grama. A few large fescue plants were pulled with a block of soil attached and dropped.

Effects of simazine on blue grama growth appeared by mid-June. Subsequently, simazine and nitrogen plots were about equally preferred. Blue grama produced especially long, slender leaves on simazine plots. This growth characteristic, as well as the absence of sixweeks fescue, could account for improved cattle preferences. In the last 3 grazing trials, the heifers selected simazine-treated plots until the leafy growth was nearly gone, then turned to fertilized plots.

Herbage Yields.—Nitrogen fertilization increased the yields of blue grama, six-weeks fescue, and "other species" by 18, 146, and 103%, respectively (Table 2). Nitrogen increased total herbage 42% over the yields of untreated plots. Simazine increased blue grama yields 32%, but eliminated annual herbs for only a 6% increase in total herbage over untreated plots. Counting all but sixweeks fescue, herbage yields were 503, 621, and 628 lb/A on untreated, nitrogen, and simazine plots, respectively. Assuming that 200 lb/A of herbage remain when this range is completely utilized, net forage yields were about 300, 420, and 430 lb/A for untreated, nitrogen, and simazine plots, respectively. This indicates a net increase of 40% in usable forage that could give added value to the treatment of an area for uniform grazing distribution.

Table 2. Herbage yields on July 5, 1962.

Species	Herbage yields by treatments: Untreated	Nitrogen	Simazine	Mean
	— — (lb/A air dry) — —			
Blue grama	469	552	618	546±151
Sixweeks fescue	90	221	0	104±103
Others	34	69	10	38± 22
Sum	593	842	628	688±162

The increase in blue grama yields with nitrogen fertilization was small and not significant (80 lb/A) in this year of moderately favorable growing conditions. Simazine increased blue grama yields 150 lb/A, but this response might have been due to physiological response as well as competition release.

Residual Effects in 1963.—Precipitation was lacking in the fall 1962, and sixweeks fescue was extremely scarce in 1963. Mean preferences were 29, 33, and 38%, respectively for untreated, simazine-treated, and fertilized plots, but these differences are not significant.

Mean frequencies of occurrence in 8 by 8-inch quadrats in 1963 were essentially the same among treatments for all species except as follows: nitrogen fertilization increased the frequency of broad-leafed sedge from 10 to 23% and sixweeks fescue from 0 to 5%, but simazine decreased scarlet globemallow from 10 to 4% as compared with untreated plots.

Herbage yields in 1963, being equal among treatments, averaged 566 lb/A of which 486 lb/A were blue grama.

Occurrence of Sixweeks Fescue.—Sixweeks fescue was found on all range sites in 1962, but it was most frequent on the "plains upland' site (Table 3). On these upland soils the fescue was abundant in ungrazed exclosures

Table 3. Distribution of sixweeks fescue in 1962 by range sites and grazing intensities.

Grazing Intensity[1]	Frequency[2] of sixweeks fescue by range sites: Sandy plains	Plains upland	Flood plain	Clay swale	Salt meadow
	— — — — — — (Percent) — — — — — —				
None	1	54±3	0	5±3	7±3
Light summer	—	70±5	—	24±5	37±6
Moderate summer	31±3	71±3	4±1	7±3	72±5
Heavy summer	43±5	60±3	0	0	55±6
Weighted mean	26	66	2	11	49
Number of macroplots sampled	14	21	7	6	5

[1]Grazing intensities practiced since 1939.

[2]Frequency of occurrence in 16-inch quadrats. We observed 250 quadrats in each macroplot. Confidence limits were interpolated from Snedecor, 1946, Table 1.1.

as well as in range units grazed lightly, moderately, or heavily since 1939. Grazed areas on "sandy plains" and "salt meadow" had 5 to 40 times the frequency of fescue as ungrazed areas on the same sites. However, even where this annual grass could be considered an invader, the moderately-grazed areas were about equal to heavily-grazed units. In 1963, sixweeks fescue was extremely scarce on all sites and range units.

Discussion and Conclusions

Sixweeks fescue is unacceptable to cattle at all seasons, and nitrogen fertilization does not increase its rooting strength or palatability. This species contributes nothing to the forage supply but interferes with blue grama utilization. Alternative practices for alleviating irregular grazing distribution include weed control or fertilization of infested areas to attract cattle.

Weed control as a possible by-product of good grazing practices is considered first. The "plains upland" range site where sixweeks fescue was most abundant is more extensive on the Central Great Plains than the other sites on this experimental range. But high frequencies of sixweeks fescue were found on this site even in exclosures left ungrazed since 1939. Therefore, this weed will not be controlled by reducing stocking rates. Fluctuating weather conditions will continue to produce sharp changes in fescue abundance unless cultural control practices are introduced.

Nitrogen fertilization increased sixweeks fescue frequency and yield, and decreased cattle preference in early May when blue grama growth was just beginning. Low preference in early May with the sixweeks fescue less than ½-inch tall could result from a disagreeable odor. This implication was partially substantiated by the total rejection of hand-clipped samples offered to cattle in dry lot. Later in the season when blue grama was green and responding to nitrogen the fertilized plots were preferred over untreated and simazine plots. Thus, on a field basis, an application of ammonium nitrate limited to infested areas would prevent the rejection of them. This practice imposes limitations. Fertilization at a cost of about $6 per acre would be necessary each year when fall weather promoted fescue establishment. Obviously, chemical control with lasting effects is needed.

Simazine was used to kill sixweeks fescue in this experiment, but other herbicides may provide equal control at less cost. Several herbicides will be compared in terms of effectiveness, cost and chemical residues because they cannot be used on a practical basis unless they leave the herbage free of residues and have to be approved for this purpose. Successful treatments will surely be developed. The emergence of sixweeks fescue in the fall when perennial grasses are dormant allows good selectivity and gives about 6 months for detection, treatment, and herbicide dissipation before spring grazing. The intermittent occurrence of sixweeks fescue will delay experimental progress.

Summary

Sixweeks fescue was evaluated as a deterrent to the utilization of blue grama by observing cattle preferences for plots untreated, fertilized with ammonium nitrate at 40 lb N/A, and treated with simazine at 3.5 lb/A. Nitrogen increased sixweeks fescue and simazine killed it. Mean preferences were 20, 40, and 40% for untreated, nitrogen, and simazine plots, respectively, but preferences changed as the season progressed. Simazine plots were always highly preferred. Nitrogen plots were preferred less than untreated ones in early May when blue grama growth was just beginning and equal to or more than simazine plots at later dates. Preferences for untreated plots decreased from 30% in May to 12% in September, indicating a seasonal gain in the deterrence associated with sixweeks fescue. Sixweeks fescue was unacceptable to cattle at all seasons, and nitrogen failed to increase its rooting strength or palatability. Yearling Hereford heifers rejected sixweeks fescue by staying away from infested plots, or by grazing carefully around the plants encountered.

Sixweeks fescue was most abundant on the "plains upland" range site, which is very extensive on the Central Great Plains. Range units on this site grazed at intensities of none, light, moderate, and heavy since 1939 all had high frequencies of sixweeks fescue in 1962. Therefore, this weed will not be controlled by reducing stocking rates. Fluctuating weather conditions will continue to produce sharp changes in fescue abundance unless cultural control practices are introduced. Several herbicides should be compared in terms of effectiveness, cost, and chemical residues to find one that can be approved for practical applications on blue grama range.

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TECHNICAL NOTES

Effect of Litter Treatment on Germination of Species Found Under Manzanita *(Arctostaphylos)*

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Factors controlling the germination of seeds on disturbed chaparral sites in Arizona have not been critically studied. However, Glendening et al. (1961), and Pase and Pond (1964) have reported that seedlings of several species not common prior to burning may be abundant in the early stages of vegetation recovery after a fire. Similar findings have been reported by Sampson (1944), Horton and Kraebel (1955) and Horton (1960), with regard to California chaparral. Sweeney (1956), Stone and Juhren (1951), and others have shown that seeds of some California chaparral species require heat, or scarification and heat, for germination.

In Arizona, the authors have observed widespread emergence of a fairly predictable array of plant seedlings on areas where disturbance of soil and litter accompanied mechanical removal of chaparral shrubs, as well as on burned sites. This paper reports the findings from a recent greenhouse study of seedling emergence in the natural soil-litter substrate collected under a dense, mature, nearly pure stand of Pringle manzanita *(Arctostaphylos pringlei)*[2] in central Arizona.

Experimental Procedure

In late November 1962, samples of the litter and top 2 to 2.5 inches of soil were carefully removed in 6x12-inch sections. Four such sections were placed in each of sixteen 12x 24x4-inch wood flats. After 4 months storage in a lath house at Tempe, the flats were moved to a greenhouse and randomly assigned to treatments as follows:

Designation	*Treatment applied to litter*
Check	Litter left in place on soil surface
Burn	Litter burned under 3 inches of excelsior
Remove	Litter carefully removed by hand
Scarify	Litter and top of soil scarified with hand-garden tool

Based on litter taken from the 4 "remove" flats, the average air-dry litter weight was 429.9 grams/ square foot (41,277 pounds per acre). Depth, based on 27 measurements at systematically spaced points in each of the same four flats, averaged 1.4 inches.

Litter was burned by igniting 400 grams of aspen excelsior placed over the litter and inside an asbestos shield along the sides and ends of the flats (Figure 1). Fusion pyrometers (Fenner and Bentley 1960) showed that temperatures of 400° F. or greater were recorded in the litter and to 0.26 inch depth in the soil. Temperatures of 200° and 250° F. were recorded at soil depths of 0.87 and 0.59 inch, respectively. Average burning time of the excelsior and litter was 3.46 minutes.

The flats were randomly arranged on the greenhouse bench (Figure 2), and on March 26, the day after burning, sprinkling with tap water was begun. Seedling emergence was tallied every 2 or 3 days during the subsequent 72-day irrigation period.

Results

A total of 81 grass, 39 broad-leaved herb, and 8 shrub seedlings were tallied (Table 1). Of these, 17 grass and 20 broad-leaved herb seedlings died while too small to be identified. Exclusive of weeping lovegrass *(Eragrostis curvula)* and Bermudagrass *(Cynodon dactylon)*, all of the nine identified species have been observed on chaparral sites following shrub canopy removal and disturbance of surface soil. Seeds of weeping lovegrass, sand dropseed, and Bermudagrass were probably introduced when an adjacent area was aerially seeded two months prior to collection of the soil samples.

Only 3 grass seedlings emerged under the burn treatment as compared with 21 or more in each of the other treatments. By contrast, fewest broad-leaved herbs occurred in the check flats, while emergence of both classes of herbaceous plants was greatest where all litter was removed and only mineral soil remained (Table 1).

The reduced grass seedling emergence on the burned flats differs sig-

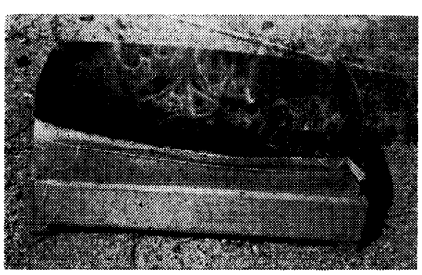

FIGURE 1. Fire burning in excelsior and leaf litter two minutes after ignition.

FIGURE 2. Arrangement of flats on greenhouse bench.

[1] *Forest Service, U. S. Department of Agriculture, with central headquarters at Fort Collins, Colorado, in cooperation with Colorado State University. Research reported here was conducted at Tempe in cooperation with Arizona State University.*

[2] *All plant names used are as given in "Arizona Flora" second edition with supplement, University of California Press, 1960.*

nificantly from that under each of the other treatments. The apparent greater emergence under the "scarify" and "remove" treatments is not significantly different from that in the check.

With the broad-leaved herbs, removal of litter by hand caused a significant increase in emergence as compared with the check. None of the other differences between treatments is significant.

Shrub seedlings were notably scarce, with a total of eight plants of yerba-santa *(Eriodictyon angustifolium)* being tallied for all treatments. Of these, five were in the burned flats.

Conclusions

1. More grass and broad-leaved herb seedlings emerged under complete litter removal than under any other treatment. This could suggest that the litter contained some inhibiting substance, but because differences in numbers of grass seedlings were found "not significant" at the 5 percent confidence level, no firm conclusion can be drawn.

2. Destruction of part of the litter by burning reduced grass emergence significantly, and, with the exception of the morningglory *(Convolvulus linearilobus)*, was not required for the germination of several broad-leaved herbs regularly seen in early post-fire successional stages in chaparral.

3. Burning of litter may have enhanced germination of yerba-santa, which is considered to be a "fire" species. Fire was not a requirement, however, because seedlings of this shrub emerged under two other treatments. Lack of emergence of other shrub seedlings must imply that the required germinating conditions did not exist under any of the treatments, or that no viable seeds were present. The latter is unlikely, because the soil was collected in a dense stand of Pringle manzanita, and seedlings of this shrub have been observed within the past year on disturbed areas near the collection site.

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Table 1. Number of seedlings that emerged during 72-day watering period.

Species	Litter treatment[1] Check	Burn	Removed	Scarify	Total
Grasses:					
Sporobolus cryptandrus	10	0	19	8	37
Eragrostis curvula	4	2	6	9	21
Cynodon dactylon	3	0	0	3	6
Unidentified	4	1	7	5	17
Total	21	3	32	25	81
Broad-leaved herbs:					
Verbena wrightii	0	0	0	1	1
Convolvulus linearilobus	0	4	0	0	4
Lotus wrightii	0	1	1	0	2
Portulaca coronata	0	0	4	1	5
Gnaphalium wrightii	0	0	5	2	7
Unidentified	2	3	10	5	20
Total	2	8	20	9	39
Shrubs:					
Eriodictyon angustifolium	0	5	1	2	8
Total Plants	23	16	53	36	128

[1]Numbers under each treatment represent the totals from four flats containing 2 square feet of soil surface each.

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Some Yield Characteristics of Range as Influenced by Soil Type and Weather

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The variations in herbage yields related to differences in soils are little known for rangelands of the Northern Great Plains. In studies of native pastures as units, there is an inescapable variation within pastures due to differences in soils.

Data on both herbage yields and mulch accumulations have been published from soil areas where the vegetation could make a normal response to climate, reflecting regional climax. Yields from relict vegetation and other protected areas with ordinary upland soils on gentle relief and no obvious inhibitory factors were reported by Larson and Whitman (1942), Quinnild and Cosby (1958), and Cosby (1960). Sarvis (1941) and Whitman (1954) reported the comparative yield by species from range grasses on upland soil types.

This study in northwest North Dakota aimed to obtain additional yield information from normal upland soils, comparable with those previously reported; then to compare production from these soils with soils that produced more or less herbage than ordinary uplands because of physical site differences within the same climate.

The help of Mr. Robert L. Howey, Soil Scientist, Soil Conservation Service, Minot, North Dakota, in describing the soils is gratefully acknowledged.

Study Area

The study was in northern North Dakota within what is known as the Souris River Area. The western boundary is in the Max Moraine, in Range 90 west, where the elevation

is between 2000 and 2500 feet, the elevation drops to about 1500 feet in the east. The east boundary is in glacial Lake Souris in Range 75 West. This area is nearly flat, "Its chief modifying features are sand dunes, some of which are 50 feet or more high, and fairly numerous depressions, which commonly contain lakes" (Lemke, 1960). Much of the intervening area is a ground-moraine plain. The study area is bounded on the north by Township 160 north and on the south by Township 151 north.

A common catena of the glacial till plains is comprised of four soil types, Zahl loam, Williams loam, Bonilla loam and Parnell silt loam.

Zahl loam consists of excessively drained, thin solum, dark colored loamy soils of the strongly convex slope breaks of the glacial till plains and morainic hills (Figure 1). The soil is representative of the Thin Silty range site.

Williams loam consists of deep-well-drained dark-colored loamy soils of the undulating to rolling till plains of the chestnut soil zone. The natural soil profile consists of a very dark brown A_1 surface horizon (2-5 inches thick) with strong granular and crumb structure over a dark brown B_2 subsoil (4-12 inches thick) with well developed prismatic structure. The noncalcareous solum varies in thickness (6-18 inches) and overlies a friable calcareous Cca horizon which grades into the unmodified glacial till parent material at depths ranging from 30 to 48 inches. The Williams soils are seasonally dry to the wilting point while the lower profile often remains dry throughout the season.

Bonilla loam consists of deep,

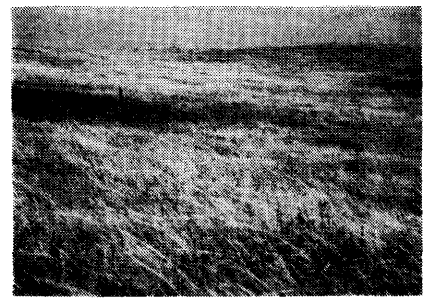

FIGURE 2. Landscape view of Bonilla loam in a broad swale surrounded by Zahl loam on ridges. This Silty range site has vegetation in Excellent range condition.

moderately well-drained, dark-colored loamy soils. It occurs on the footslopes and swales of the glacial till plains and morainic hills (Figure 2) and is in the Silty range site.

Parnell silt loam is a deep, moderately fine-textured black soil which occurs in the closed depressions of the glacial plains and moraine where they are subject to seasonal ponding. This soil is included in the Wet Land range site.

Sioux loam is closely associated with the above catena in the glacial plains. It consists of shallow dark-colored loamy soils underlain by gravel outwash at depths of 6 to 15 inches, which limit moisture storage and root development. The range site is Shallow to Gravel.

Arnegard silt loam is a deep, loamy, dark-colored alluvial soil of the sloping concave hillside slopes of the Souris River breaks (Figure 1). The soil is included in the Silty range site.

Coarse Dune-sand is a land type which consists of deep, loose, coarse, sand material with very little silt or clay content. It is very low in organic matter and water holding capacity. The range site is Coarse Sands.

Final correlation of soil names has not been made in the area. Range site names are those used by several agencies in range classification.

Vegetation is generally typical of the Mixed Prairie of the Northern Great Plains as described by Weaver and Albertson (1956). Undescribed however, is the presence of rough fescue *(Festuca scabrella)* in the northwest portion of the study area. It is the predominant species on many north-facing slopes, in this locality of the Max Moraine. The rough fescue areas are much like the Fescue Grassland described by Coupland and Brayshaw (1953). Also undescribed is the local abundance of slough sedge *(Carex atherodes)* and rivergrass *(Scolochloa festucacea)* which produced almost all of the herbage from Parnell silt loam.

Average 54-year annual precipitation at Powers Lake, near the west side, is 15.57 inches and at Towner on the east side it is 16.05 inches. This is a difference of only .48 inch from west to east.

Locations were picked for their high range condition and long rest period. Most of the data were obtained from a portion of the Lostwood National Wildlife Refuge on which there had been no grazing by domestic livestock nor haying since about 1935. On the east end, the Coarse Dune-sand is on an area with about the same rest time. There is no indication that erosion had occurred during recent times on the coarse dune-sand plot locations. They apparently had been stable during the drought of the thirties. Range condition at all plot locations were determined to be in the "Excellent" class (Dyksterhuis, 1949).

Circular 9.6 square foot plots were clipped from 1958 to 1963 in areas located for a specific soil type with a typical plant community, a soil with a special plant community, or one on which the plant community might be affected by exposure. Procedure in clipping, segregating, and naming materials followed that described by Dyksterhuis and Schmutz (1947). Herbage from the coarse dune-sand was divided into two categories but not from any other plots. Clippings were made at approximately the same time each year. The earliest date was August 27 and

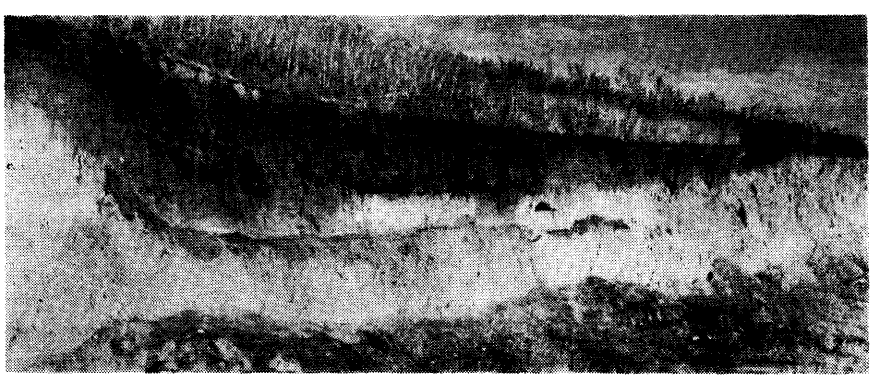

FIGURE 1. Cross section of steep hillside showing variability of profile development. Thin profile to right, typical of Zahl loam, is on a strong convex position. The thick Arnegard loam profile in the center occupies a slight swale, sloping steeply to the east; it receives extra run-off from thin soils above, also considerable snow drift.

the latest October 4.

Plant species were recorded for each plot clipped and the percentage of total herbage contributed by species was estimated. New plots were used each year except in the rough fescue community where repeated clippings were made on two plots.

Results

The effect of soil type on total annual herbage yield is reflected in the results from a common soil catena in the Northern Mixed Prairie (Table 1). The annual herbage yield from excellent condition range on a Williams loam illustrates normal productivity in this climatic area. The more xeric Zahl loam yields less because of excessive runoff. The Bonilla loam is slightly more mesic than Williams loam because of local run-in and snow catchment, resulting in more total yield. Parnell silt loam yields extremely high when sufficient ponding occurs but is also subject to drought when there is no ponding. Vegetation for each soil type of the catena was regarded as typical for the soil type.

No yield data were collected in 1959. The average yield for Zahl loam was taken from 1960 through 1963. The highest yield was in 1963, the lowest in 1961. Average yield for Williams loam and Bonilla loam was collected 1958 through 1963 excepting 1959. The highest and lowest yields on Parnell silt loam were collected in 1961, the driest year of the period. The location having the highest yield received sufficient spring run-in for high production while the other remained dry. Mulch accumulation is the average of all plots by soil type for all years.

Sioux loam yielded an average of 1255 lbs. per acre during the 5 year period, with a high of 1500 lbs. in 1962 and a low of 770 in 1961. The average fresh mulch accumulation was 858 lbs. per acre and humic mulch 534.

Two types of plant community on Williams loam with a 15% north-facing slope were clipped for comparison of yield with the typical community. Average annual herbage yield from a rough fescue community for 5 years was 2892 lbs. per acre; highest yield was 3280 lbs. in 1963 and lowest 2130 in 1960. Average fresh mulch was 5424 lbs. per acre and humic mulch 5186 lbs. Very few seed heads were observed on rough fescue until 1963 when they were numerous. A mixed plant community dominated by needleandthread *(Stipa comata)*, on the same slope yielded 2344 lbs. per acre. The highest yield was 3210 lbs. per acre in 1958 and the lowest 1720 lbs. in 1961. Fresh mulch was 4666 lbs. per acre and humic mulch 5122 lbs.

No one factor is more important than moisture in a grassland climate. Dix (1958) determined moisture to be the most important single factor in determining kinds and numbers of plants to occupy given sites. Variables such as exposure, slope and topography, he found important only so far as they influenced soil moisture. The effect of plant and soil moisture relationship in soil development is apparent in the soil descriptions. Recent plant and soil moisture relationships, as influenced by soil type and weather, are reflected in the herbage yield.

Cool season grasses predominate over warm season ones in the northern Mixed Prairie. In this area available moisture most often favors the cool season species. Soil is generally frozen 4 to 5 months. Rapid growth of cool season species follows the spring thaw and they are further favored by normally higher rainfall months immediately following. Arnegard loam on a south-facing slope of 25% was dominated by the warm season big bluestem *(Andropogon gerardi)* with prairie sandreed *(Calamovilfa longifolia)* secondary. Total annual herbage yield from this soil was 1340 lbs. per acre in the drought year of 1961. In 1962, a year when summer rain was above normal, yield was 3420 lbs., an increase of 2½ times. The increase between high and low years was least on Williams loam with a rough fescue community (1½ times).

Coarse dune-sand produced the least herbage of any soil or land type in the study. It was sampled only for the most favorable year, 1962. Total annual herbage was 1135 lbs. per acre, approximately 42% of a mixed plant community on Williams loam for the same year. Field sagewort *(Artemisia caudata)*, a low value forage plant, was segregated from other herbage and weighed separately. It contributed 56% of the total yield on open grasslands of the land type. No data were taken on areas where scrubby trees were a highly significant part of the vegetation. Of particular interest was a lichen *Cladonia tenuis*, common to the immediate area but not encountered on plots.

Observation of clipped plots showed an apparent decrease in herbage yield the year following clipping (Figure 3). The 1961 yield from a rough fescue community on a plot not previously clipped was 2910 lbs. per acre in 1961. Leaf lengths were 16 to 20 inches, fresh mulch was 6250 lbs. per acre and humic mulch 5170 lbs. A nearby plot, clipped in 1960 was reclipped, the yield was only 630 lbs. per acre and leaf length 3 to 8 inches. Three plots were used in the rough fescue community in 1962. One was not previously clipped, one was clipped two successive years and one for three years. The per-acre yields were 2960 lbs., 2060 lbs., and 1960 lbs. respectively. The drought year of 1961 showed a more adverse effect on the repeated clippings than did the more favorable season of 1962. Johnston (1961) reported growth was similarly retarded on rough fes-

Table 1. Total native herbage and mulch yields (air dry) from a common catena of glacial soils in northwest North Dakota.

Soil Type	No. Yrs.	Total Annual Herbage			Fresh Mulch	Humic Mulch
		Average	Highest	Lowest		
		(Pounds per acre)				
Zahl loam (convex slopes and ridges)	4	1477	1880	990	1771	2037
Williams loam (general upland)	5	2016	2665	1350	3335	5355
Bonilla loam (concave slopes)	5	2457	3527	1560	4080	5639
Parnell silt loam (closed depressions) "Pot-hole"	1	.....	7920[1]	2320[2]	6383	22110

[1] Normal ponding
[2] No ponding

cue from close clipping under greenhouse conditions.

Summary and Conclusions

A sampling study was made of herbage yields by specific soil types in the Souris River area of North Dakota during 1958, 1960, 1961, 1962 and 1963. Sampling areas were selected from representative soil types and Excellent range condition.

A common catena was sampled in which Williams loam, a typical zonal representative of the Chestnut soils, was indicative of ordinary uplands on which vegetation can make a normal response to climate, reflecting regional climax. Average herbage yield was 2016 lbs. per acre, air dry, for the five years. The largest yield was from Parnell silt loam because of superior moisture availability from trapped run-in water. The greatest total annual yield from this soil (7920 lbs per acre) was approximately 3 times the highest yield from Williams loam. The most xeric of all soil types sampled was coarse dune-sand. The average herbage yield of all plots for one favorable year (1962) was 1135 lbs. per acre, 42% of Williams loam for the same year.

Cool season grasses are more common to climax vegetation of the northern Mixed Prairie than warm season species. Weather normally favors their growth soon after spring thaw. A wider annual yield variation occurs on warm season species which are more dependent on timely summer rains.

On native perennial grasslands the potential average annual yields may vary greatly among mature soils of a catena. When the yield from a climatically normal soil was compared with yields from other mature upland members of a soil catena in the same macroclimate, differences approximated 25% over and under the yield from the normal soil. If immature and depressional members of the catena are included, the variation may approximate 100% up or down from the normal soil. Moreover, production on any upland member of such a catena in wet years may be double that in dry years—with even greater differences on members subject to ponding.

Differences in kinds of plants composing climax plant communities on a single member of a catena, in the same macroclimate, generally produced essentially the same total annual yield. However, a consociation of rough fescue on a normal profile produced more than other communities sampled on the comparable soil.

In areas long protected from grazing, the average amounts of both fresh and humic mulch varied directly with the natural productivity of soil members in a catena.

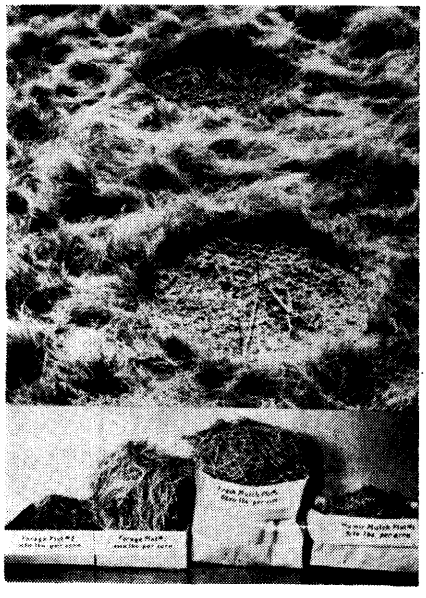

FIGURE 3. *Top:* Two plots in rough fescue community on Williams loam, 15% north slope. Upper plot not previously clipped; lower plot clipped 1960 and 1961. *Bottom: L.* to *R.:* Forage from previously clipped plot; forage, fresh mulch, and humic mulch from plot unclipped previously.

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Evidence of Hybridization Between Certain Browse Plants

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In the fall of 1935, plants were observed in Logan Canyon, Utah, that had certain characteristics resembling birchleaf mahagony *(Cercocarpus montanus)* and others resembling curlleaf mahogany *(C. ledifolius)*. Subsequently similar apparent hybrids were found elsewhere in the state.

During the winter of 1948, plants were found in the vicinity of Providence Canyon in northern Utah which were not typical of antelope bitterbrush *(Purshia tridentata)* nor cliffrose *(Cowania stansburiana)*, but resembled both. Subsequently plants showing similar intergradations have been observed throughout Utah by the writer and others.

Field observations and feeding tests indicate that the *Cercocarpus* hybrids provide excellent forage for deer. In view of the increasing need to revegetate overused browse ranges, further information regarding these suspected hybrids may be valuable.

Methods

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Methods

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len from known sources was introduced into the bags. Some individual flowers were enclosed in drug capsules.

Six crosses were attempted: [1]Cmo x Cle; Cmo x Hyb; and Cle x Hyb, each plant alternately providing and receiving pollen.

No attempts were made to cross cliffrose with bitterbrush. Typical material was collected from different localities and compared to plants exhibiting signs of hybridization. Cliffrose was obtained from Stansbury Island, the type locality. Antelope bitterbrush was obtained from northern Utah and southern Idaho, north of the range of cliffrose. Desert bitterbrush *(Purshia glandulosa)* came from Beaver Dam Wash in southwestern Utah. These materials were compared to collections from a suspected interbred population with respect to several gross morphological characteristics.

Results

Attempts to hybridize the *Cercocarpus* species were first made in 1957. Plastic food bags were used to enclose the branches selected for treatment. They proved to be too nearly airtight. Transpired moisture accumulated in them and temperature inside became high. Small vents and a coating of aluminum paint failed to correct these difficulties. The drug capsules were too heavy for the small flowers. In consequence of these difficulties, only ten mature seeds were obtained by controlled pollination (Cle x Cmo). Twenty-five seeds were recovered from a bagged unemasculated branch of a natural hybrid plant which apparently were the result of selfing.

Further attempts at crossing were made in 1958. The selected branches were first enclosed in paper bags which in turn were covered with loosely fitting plastic bags left open at the bottom, thus permitting free circulation of air still providing protection from rain.

The weather, however, was not favorable to flower production on an extensive stand of birchleaf mahogany near the mouth of Logan Canyon which was to have been the major source of study material. By the time this species was flowering at the upper limit of its distribution in Logan Canyon, curlleaf mahogany had completed flowering except at the mountain summit. This greatly limited the opportunities for controlled pollination. Thirty crosses, each representing 6 to 15 emasculated flowers were attempted. Eighty seeds were collected (Table 1).

The apparently viable seeds were stratified in peat moss at temperatures of 35° to 45°F. The 1957 materials were held in a cold chamber 30 days, the 1958 seeds for 50 days. All were then placed in sand for germination. When it appeared that no germination was forthcoming, the seeds were recovered. Most of them upon being cut open were found to be dark and discolored. Thirteen, however, appeared to be in good

Table 1. Results of crossbreeding attempts with plants of the genus *Cercocarpus*.

Year	Number of attempts[1]	Plant pollinated	Source of pollen	Number of seeds recovered	Comments
1957	2	Hyb	Cle	0	Fruits started to develop
	2	Hyb	Cmo	0	No response observed
	1	Cmo	Cle		Fruits started to develop
	1	Cmo	Hyb	0	Bags destroyed
	1	Cle	Cmo	10	
	1	Cle	Hyb	0	No response observed
1959	1	Hyb	Cle	0	Fruits partially developed
	2	Hyb	Cmo	2	
	7	Cmo	Cle	7	
	8	Cmo	Hyb	19	
	6	Cle	Cmo	25	
	6	Cle	Hyb	27	

[1] Each attempt represents a branch with 6 to 15 flowers.

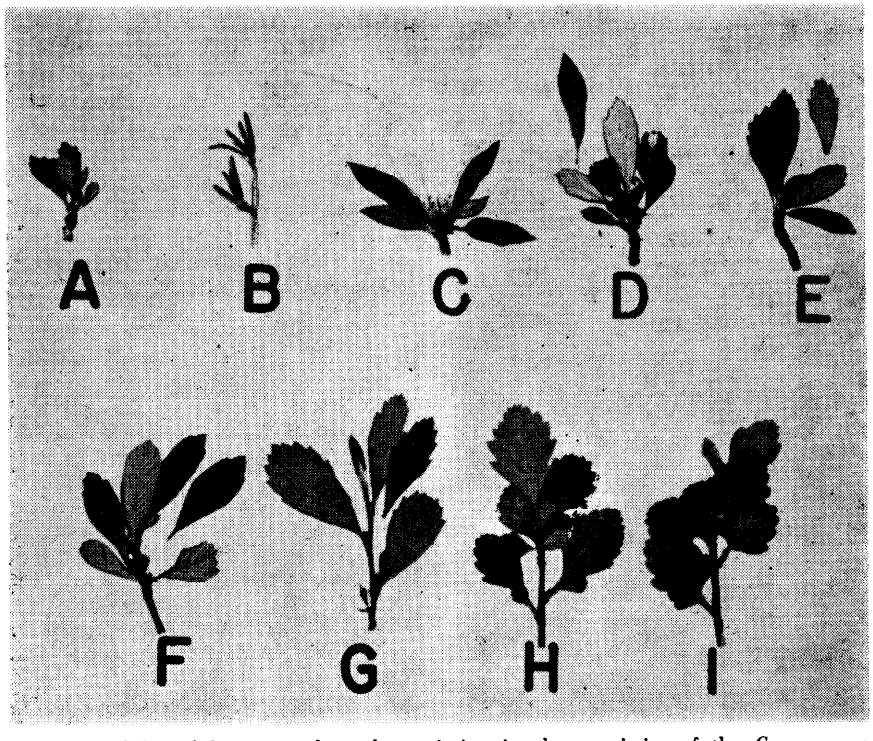

FIGURE 1. Selected leaves to show the variation in characteristics of the *Cercocarpus* complex. Each is from a different plant. A, Fully developed evergreen leaves, dentate at tips, the size suggesting a cross between *C. intricatus* and *C. montanus*. B, *C. intricatus*. C, *C. ledifolius*, leaves evergreen and entire. D, E, & F, Leaves evergreen with variable leaf shape and dentation. The form of these plants is similar to *C. ledifolius*. G and H, These are close to *C. montanus*. The bushes are low and multi-stemmed. Although they are largely deciduous, some leaves remain green all winter. The dentation of G does not approach the leaf base. I, Typical *C. montanus*.

[1] *Cmo* = Cercocarpus montanus; *Cle* = C. ledifolius; *Hyb* = *natural hybrid.*

condition and still capable of germination.

Various circumstances made it impossible to continue the study after 1958.

In spite of failure to produce plants by controlled crossing, the supposition remains strong that such crosses occur in nature. Figure 1 portrays the great variation in leaf characteristics of *Cercocarpus* plants collected from a small area near the mouth of Logan Canyon, which appears to support this belief.

Purshia-Cowania Complex

The data obtained from examination of this group are difficult of summarization. Morphological characteristics occur in such a variety of combinations that none is a dependable criterion. As in the *Cercocarpus* complex, gradual inter-gradations can be observed. An array of fruits and leaves illustrating the many gradations found is shown in Figure 2. It will be observed that the leaf characteristics are more erratic than the fruit. Moreover a diversity of leaf form can be observed on different parts of the same plant.

Thomas (1957) was of the opinion that *P. glandulosa* resulted from a cross between *P. tridentata* and *Cowania*. Except for its fruits, in respect to which it most closely resembles *P. tridentata, P. glandulosa* appears very like cliffrose. The material collected near Providence followed none of the three species closely. Individual characteristics most nearly resembled one or another of the species in turn.

Nord (1959) has called attention to that fact that a presumed hybrid between *Cowania* and *Purshia* was collected in Nevada in 1898 by C. A. Purpus. This since has been named *C. mexicana* var. *dubia McMinn.* This is described as having 2 or 3 fruits per receptacle. The material from Providence shows 2 to 6 fruits, although, more "typical" hybrid plants observed have 3 or occasionally 4 fruits.

Figure 3 presents graphically the characteristics found in the Providence material and compares them to the recognized species in this area. Maximum, minimum, and mean values for eight characteristics thought to be of possible usefulness in identifying individual members of this complex were plotted for cliffrose and the two bitterbrushes.

Individual values for these same eight characteristics from selected plants from the Providence area were plotted on the same graph. They tend to fall between the means of cliffrose and antelope bitterbrush although there is great variation. Plant 1161, for example, shows

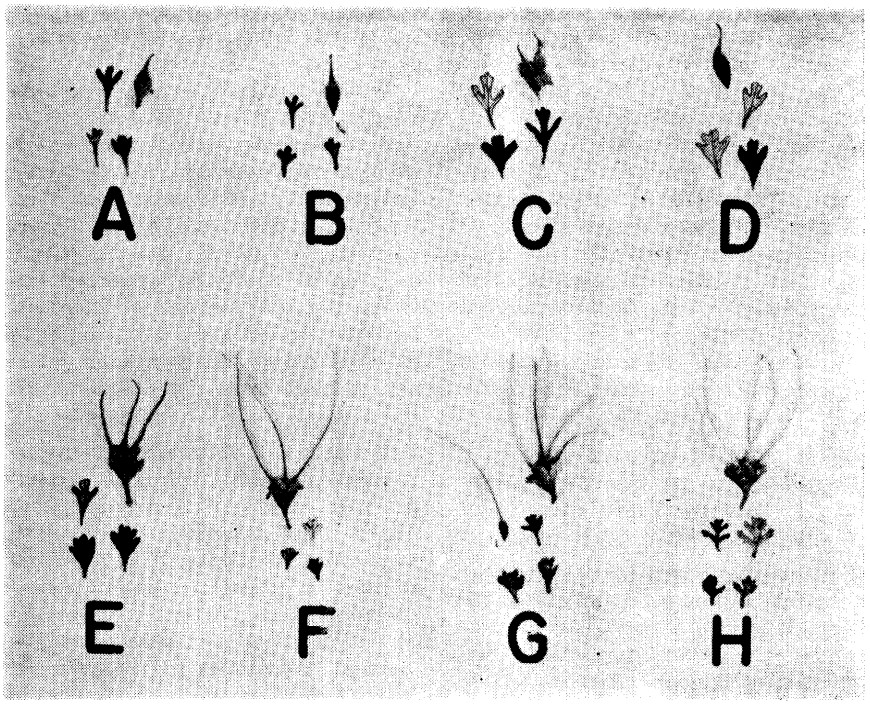

FIGURE 2. Fruit and leaves of the *Purshia - Cowania* complex. A, typical *Purshia tridentata* from Smithfield, Utah. B, *Purshia glandulosa* from Beaver Dam Wash, southwestern Utah. C, Plant 543 near Providence, Utah. Note the twin seeds. D, Plant 589 near Providence. Although one seed predominates, the beak is longer than on typical *P. tridentata* and is slightly pubescent. E, Plant 572, Providence, Utah, with three seeds whose tails are rather long and becoming plume-like. The leaves are broadly lobed with weakly revolute margins and resemble *P. tridentata* leaves. F, Plant 3584, Providence. Long plumes are present but there are fewer seeds than are characteristics of *Cowania.* G and H, From plants on Stansbury Island, the type locality for *Cowania stansburiana.* Note the 7-lobed leaves of H.

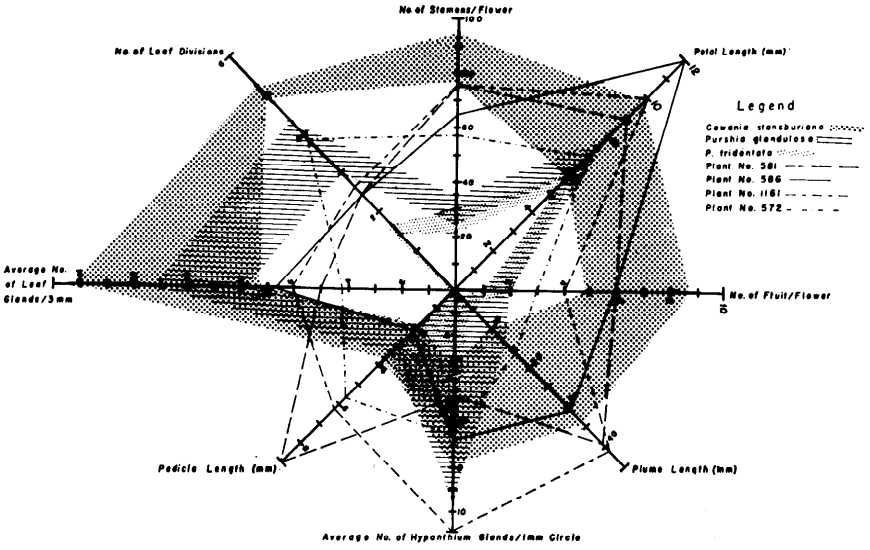

FIGURE 3. Range in values of selected characteristics of *P. tridentata, P. glandulosa,* and *Cowania stansburiana* compared to individual plants found near Providence, Utah.

maximum values for hypanthium glands and plume length but has fewer achenes than cliffrose and all but one of the hybrids shown in the graph. Plant 581 is but moderately glandular, but with respect to leaf divisions and pedicel length it approaches maximum values.

The data obtained from the Providence population do not suggest that we have a true variety, for there is no consistent combination of characteristics that can be recognized. In some instances the foliage characteristics are essentially like those found on *P. tridentata,* while other characteristics may be intermediate or close to cliffrose.

The evidence here would better support the view that the plants under observation are a result of random cross pollination among the parents and hybrids resulting in a wide variety of genetic combinations.

An attempt was made to germinate seeds from hybrid material collected near Providence, Utah, but without success though Plummer (1957) reports having done so.

Data were collected on the palatabilities of these hybrids for deer. Individual plants were identified, tagged, and measured in the fall and again in the spring. No significant differences could be observed between the palatabilities of *Cowania, Purshia tridentata,* and hybrid plants, although differences in palatability have been noted among the recognized species when they occur together in other areas.

Cytological studies are probably necessary to define the true status of these plant complexes.

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Effect of Time of Fertilizer Application on the Seed and Forage Yield of Russian Wild Ryegrass

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Several workers have pointed out that the application of nitrogen fertilizers and use of wide row spacings increased seed yields of Russian wild ryegrass, Stelfox et al. (1941), Stitt (1954), Heinrichs and Lawrence (1956), and Lawrence (1963). Others have reported on the influence of fertilizer and row spacing on the forage production of this grass, Kilcher (1958 and 1961), Lorenz and Rogler (1959), and Smika et al. (1960). Both nitrogen fertilizer and wide row spacings were found to give increased forage yields.

Very little work has been reported on the influence of time of fertilizer application on the production of the Russian wild ryegrass. Stitt (1954), on the basis of limited observations, indicated that early spring was probably the best time to apply fertilizer for increased seed yields. The present study was undertaken to determine the influence of time of fertilizer applications on the seed and forage yields of Russian wild ryegrass.

Experimental Methods

Russian wild ryegrass was seeded in 1951 in rows two feet apart on an irrigated clay soil at Swift Current, Saskatchewan. The experimental design was a split-plot with six replications in which fertilizers constituted the main plots and time of fertilizer application the sub-plots. Ammonium nitrate, 33.5-0-0, and ammonium phosphate-sulphate, 16-20-0, fertilizers at rates supplying 50 pounds of N per acre were applied at four times of the year, in July (mid-summer) immediately after seed harvest, on September 15 (early fall), on October 15 (late fall), and in April (spring). Fertilizers were applied as a seeded band 6 inches to the side of each grass row and 1 to 1.5 inches deep. The grass was irrigated three or four times during the growing season to apply approximately 10 inches of water to supplement the seasonal rainfall of 6.6 to 10.4 inches during the 5 year period.

Heading was sparse in 1952 and no yields were taken. In 1953, 1954, and 1955 seed yields and forage yields were obtained by harvesting the grass for seed with a hand sickle and cutting the aftermath for forage.

Results

Seed Production.—In the first two crop years Russian wild ryegrass fertilized immediately after seed harvest produced about three times as much seed as when it was fertilized at other times (Table 1). However, in the third year, fertilization in the spring resulted in seed yields as great as those obtained from other application times. The

Table 1. Seed yields in pounds per acre of Russian wild ryegrass as influenced by time of fertilizer application.

Fertilizer and time of application	Year 1953	1954	1955	Mean
33.5-0-0				
After seed harvest (July)	196	172	60	143
September 15	76	62	16	49
October 15	76	20	9	35
Spring (April)	77	62	66	68
Mean	106	79	38	74
D[1]	21	14	20	22
16-20-0				
After seed harvest (July)	234	122	26	127
September 15	60	51	25	45
October 15	82	36	15	44
Spring (April)	66	51	76	64
Mean	110	65	36	70
D	21	14	20	22

[1]D is the difference required for significance at P = .05, as outlined by Snedecor (1961).

lowest average seed yields were from stands which had been fertilized at either of the two fall dates.

The source of N had no apparent bearing on seed yield and thus the use of a fertilizer containing phosphorus was not warranted.

Forage Production.—Except in the first crop year, 1953, dry matter yields were greatest from stands fertilized in the spring (Table 2). Yield increases attributable to spring applications of fertilizer ranged from 22 to 120 percent when compared to other dates of application.

Here again the source of N was unimportant except that N in the form of 16-20-0 is more expensive than N in the form of 33.5-0-0.

Table 2. Dry matter yields in tons per acre of Russian wild ryegrass as influenced by time of fertilizer application.

Fertilizer and time of appplication	Year 1953	1954	1955	Mean
33.5-0-0				
After seed harvest (July)	1.67	.91	.92	1.17
September 15	1.41	1.07	.99	1.16
October 15	1.46	1.14	1.01	1.20
Spring (April)	1.54	1.95	1.48	1.66
Mean	1.52	1.27	1.10	1.30
D[1]	.15	.40	.20	.16
16-20-0				
After seed harvest (July)	1.75	.87	.77	1.13
September 15	1.35	1.14	1.04	1.18
October 15	1.58	1.04	.91	1.18
Spring (April)	1.12	1.86	1.27	1.42
Mean	1.45	1.23	1.00	1.23
D	.15	.40	.20	.16

[1]D is the difference required for significance at P = .05, as outlined by Snedecor (1961).

Discussion

The marked increase in seed yields attributable to after-harvest applications of fertilizer in this study may seem to be at variance with the results obtained by Stitt (1954). However, Stitt's fertilizer treatments were made as late as September so that subsequent seed yields were not the result of after-harvest treatment as much as they were the result of fall applications. Fall applications, even in the present study, resulted in seed yields that were generally smaller than those from spring applications.

The decline in seed yield in 1955 agrees with earlier reports, Lawrence (1963), and Lawrence and Ashford (1964), who noted decreasing yield with increasing age of stand. As in the present study they reported yield decreases even when fertilizer was applied.

The high vegetative response to spring applications of fertilizer, and the high seed yield response to after-harvest applications, suggest that the best use of a Russian wild ryegrass stand might be achieved by split applications of fertilizer. This type of fertilizer management might be especially important where the herbage aftermath will be intensively grazed during the fall season. The necessity of aftermath grazing for maintaining seed yields has been pointed out by Lawrence and Ashford (1964). Studies are being conducted to determine the influence and soundness of split applications of fertilizer on the overall production of Russian wild ryegrass.

Summary

In two of the three years Russian wild ryegrass fertilized immediately after seed harvest in July produced significantly more seed than when it was fertilized as other times of the year. Russian wild ryegrass fertilized in the spring (April) produced higher dry matter yields than that fertilized at other times of the year. No differences in seed or dry matter yields could be attributed to the source from which N fertilizer was obtained. Both seed and dry matter yields tended to decrease with increasing age of the stand.

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MANAGEMENT NOTES

Integrated Management of Public and Private Lands

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Land ownership patterns intensify the complexity of grazing-land management. Frequently, a ranch operation is based upon the integrated use of several ownerships, each of which may have a different viewpoint or different objectives in regard to resource management. It is easy to understand how "operating for profit" a ranch unit made up of multiple ownerships may well create a dilemma for the ranch manager. The rancher should not have to face this problem alone. Everyone interested in the full development and wise use of our range and related resources should assume their proportionate share of the responsibility for resolving this problem.

The Problem

The magnitude of the problem, encompassing major portions of the United States, quickly becomes apparent to those interested enough to take a close look. The economic and sociological contributions of the range resource to the welfare of the nation is obvious. Some may feel that the livestock industry motivated by the profit motive should take the major responsibility and shoulder the major cost of development of the range resource. Certainly, the livestock industry must play an important role. It should take a major part in that phase of range resource development that contributes directly to industry income. The integrated development of public and private lands is a program of interested parties working together for sound development of the resource for the long run, and should offer opportunity both for profit for the individual operator and maximum sustained use of the total resource.

What Should Be Done

It would appear that for maximum development and utilization, a program of integrated resource management should be developed. Such a program need not relieve any individual or agency from the responsibility of wise management, or deprive any of their rights, or usurp their legal power. It would simply mean that all ownerships involved within any management unit would plan together for its wise development and use. It would mean that all ownerships must realize that any management decision made on a given piece of land has implications far beyond its boundaries. When given the opportunity, implicated ownerships may well contribute constructively to management decisions that would contribute to development of the total resource.

Acceptance of such a concept would mean acceptance of the fact that to some degree "we are all our brothers' keepers."

On a bit lower plane, it would also have value in a more practical way. Intergrated development of all land, public and private, should provide maximum economic return to the individual, the community, and the nation. For example, it is difficult to justify extensive development and improvement of public lands under the guise of increased forage production when development of private land is lagging to such a degree that base properties will not support increased production. On the other hand, operators may have developed private lands to about their potential and await improvement and development of public lands for further development. Balanced development of public and private lands, with funds extended by government or individuals, in a manner resulting in maximum returns, consistent with sound land use, appears to be a logical means of range resource development. In this kind of a resource development program, full consideration must be given to other interests such as wildlife, recreation, watersheds, etc. In other words, such a program as this would of necessity require sound overall initial planning.

How Could It Be Accomplished

A program of integrated resource management would necessitate an amalgamation of land ownerships to logical management units. Meadow lands, hay lands, pastures, and range lands of each management unit would be managed to provide an economical year-round forage supply for grazing animals. No operator or agency would or should think in terms of the productivity of an area by itself, but rather its productivity when integrated with all lands making up the management unit.

No new agencies need be created or laws passed for a program of integrated resource management to function. Sufficient flexibility exists in the laws dealing with management of lands. Adminisitrative decision could set the stage for program modification to emphasize the idea. Some educational effort may also be required to obtain public understanding and acceptance. Mechanisms now exist in universities, experiment stations, extension services, and federal agencies to provide the educational assistance.

Our society will continue to become more complex. Population increases will exert pressures on our natural resources at an accelerated

rate. These factors will force the adoption of this kind of program sometime in the future. We who are charged with the responsibility for development of the range and related resource should take the leadership in developing such a program. We should take the leadership while there is still time for early planning and development of the range resource, for wise use in the long run.

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Effects of Drouth on Mesquite

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Comments from old time ranchers and historical documentation (Inglis, 1961) indicate a substantial increase of thorny type brush including mesquite (*Prosopis glandulosa* Torr.) in south and southwest Texas during the past hundred years. A fairly common expression among the older ranchers is, "We used to dig for firewood," referring to the digging of mesquite roots in the then treeless grasslands. Likewise, "In those days we could see a cow for miles," is often volunteered in commenting on the dense stands of mesquite now occupying the same land.

The spread of mesquite has been attributed to many causes, with over-grazing, trailing, and associated soil and cover disturbances as the principal mechanisms. The effects of fire in both suppressing and opening the way to invasion of mesquite are also cited (Parker, 1952). A few authors refer to drouth, particularly in its adverse effects on grass competition (Young, 1948), as a major climatic hazard favoring spread of mesquite.

There is little in the literature on the direct effects of drouth in eliminating or reducing invaded or residual stands of mesquite in south Texas.

Drouth Kills Mature Mesquite

During the period 1950 to 1963, observations were made of the effects of drouth on mesquite in an eleven county area of the westernmost South Texas Plains comprising 7,500,000 acres of mesquite infested rangelands. The period of observation coincided with the most severe drouth on record from 1950 through 1956 (Waldrip, 1957). Rainfall during these seven years amounted to 64 to 75 percent of normal, depending on location. Effective precipitation, based on rainfall at Carrizo Springs (Dimmitt County) of amounts greater than one inch, amounted to less than eight inches per year for seven years. Average rainfall for the area is 18 to 28 inches, from west to east.

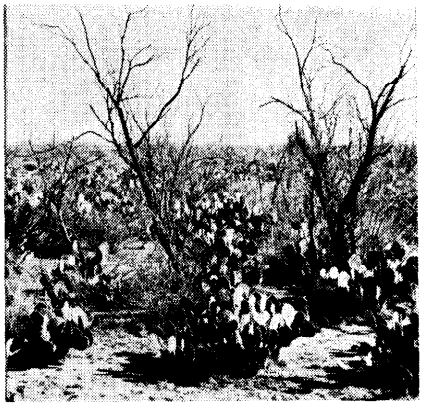

FIGURE 1. Overstory of drouth killed mesquite with a living understory of Opuntia, Acacia, and Aloysia species. SCS Photo.

The resistance of mesquite to drouth is well known. Notwithstanding, substantial kills of mature mesquite were observed on all range sites under all range conditions except on gravelly soils. The shrubs were considered dead when no resprouting occurred within two years after the end of the drouth. Losses, while not area wide or of all age classes, were general throughout the area. Hardest hit stands occurred on Leona clay and Frio silty clay loam bottomland sites and Montell clay flat and saline clay sites. Uvalde silty clay loam, Maverick clays, Monteola clays and Duval fine sandy loam upland sites also showed considerable losses. The kill of mesquite on these sites approached 40 percent.

Counts of dead and live plants on line transects showed some interesting ecological phenomena. Broad bottomland sites on the Nueces River near Crystal City (Zavala County), where overflow could be expected at least once every 5 years but did not occur during the drouth, showed 75 percent death loss of mature trees. Narrower bottoms receiving some overflow showed no observable losses. Immature mesquite with stem diameters of 1 to 3 inches either in pure stands or mixed with larger trees withstood the drouth on all range sites. Most such plants appear unaffected in 1964.

Mesquite stands of all age classes that were previously chained for control and subsquently branched out at ground level were largely unaffected by drouth. Young mesquite on areas rootplowed in former years showed no mortality. Mature untouched stands of mesquite with understories of heavy grass suffered greater drouth kill than on overgrazed areas on the Captain Burr Ranch in Maverick County. Strangely enough, there was little drouth kill of mesquite on accidentally burned heavily grassed areas near La Pryor (Zavala County) on Uvalde silty clay loam site. Mature scattered trees on saline soils on the Burr Ranch were largely killed by drouth, yet multistemmed plants or young trees escaped.

Understories of associated brush including species of *Acacia, Condalia, Opuntia, Aloysia, Celtis* and *Rhamnus* on most sites were thinned out or died back to the bud crown. Plants of these genera were rarely killed and made rapid recovery. In 1964, such areas present a living understory aspect with a dead mesquite overstory.

Large scale mortality of mesquite apparently requires several consecutive years of drouth since most kill took place during the last two years of the drouth. It follows that severe drouths of one to two years' duration would have little effect in south Texas as confirmed in the severely dry years of 1961-62 when no observable losses occurred.

Brush control methods, both mechanical and chemical, have been used for many years in south Texas (Davis, 1961) on mesquite and asso-

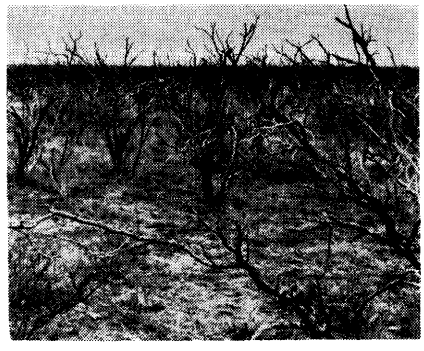

FIGURE 2. Near total drouth kill of mesquite on clay flat range site. Winter Garden Soil Conservation District Photo.

ciated brush. Such efforts, though extensive, have resulted in less elimination of mesquite than the drouth of 1950-56.

Conclusion

The seven years of record breaking drouth from 1950 through 1956 eliminated or thinned out large areas of mesquite on nearly all range sites in a large area of the South Texas Plains. Young trees or trees with several stems resulting from chaining for control were largely unaffected by drouth. Although grass competition appeared to hasten the mortality of mesquite, substantial kills were noted on all degrees of range condition. Since early day ranchers once dug mesquite stumps for firewood in what were open grasslands at the time, it appears reasonable to suppose that recurring severe drouths must be considered as a natural control for mesquite.

Considering the time span that mesquite has been on hand to spread and occupy grasslands, extended drouths may account for the natural advance and retreat of mesquite into grasslands, similar to the better known advances and retreats of forest species into prairie soils. Human manipulations of rangeland environments with grazing animals have obscured the natural ebb and flow of mesquite but generally in favor of wider dispersal.

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Plant Display Board Sells Good Management

ROBERT F. PEARSON, JR.
Soil Conservation Service, U. S. D. A., Benavides, Texas

In Benavides, Texas, the Soil Conservation Service technicians assigned to the Agua Poquita Soil Conservation District have hit upon an effective way to help livestockmen understand the value of conservation range management.

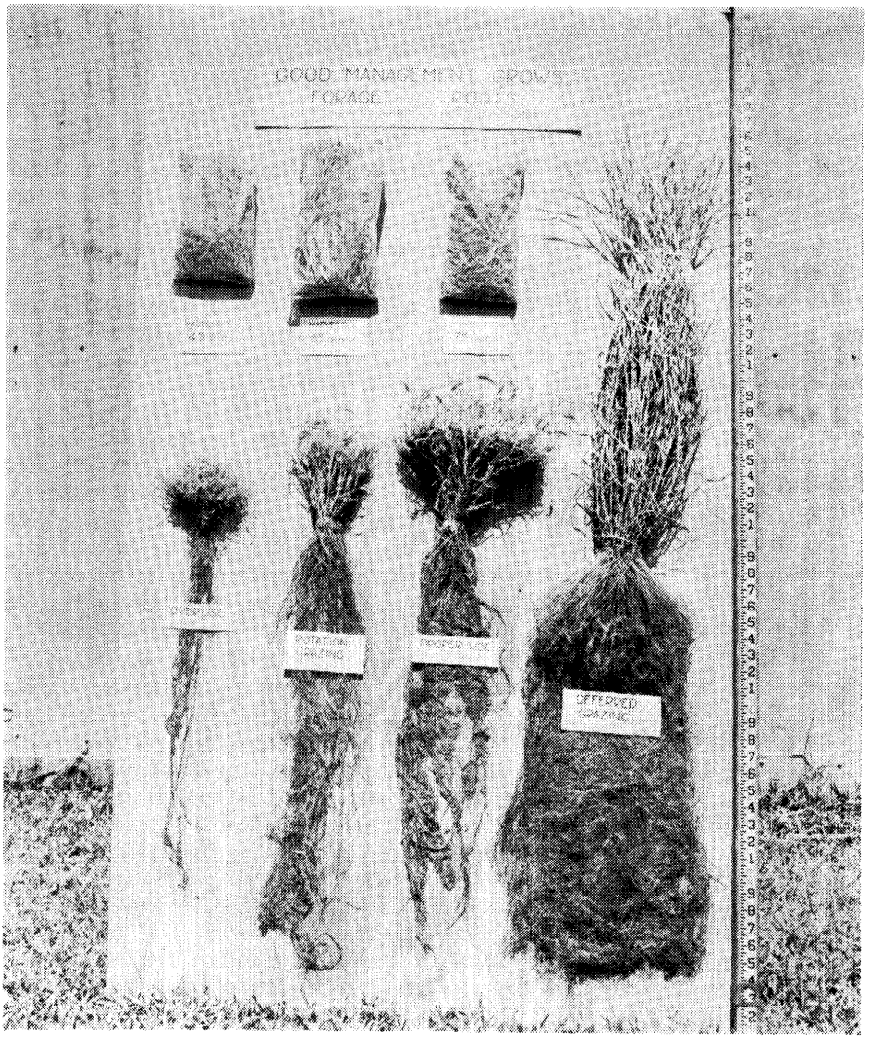
They planted, grew and "managed" a locally used grass (buffelgrass, *Pennisetum ciliare)* under conditions approaching those of grazing use.

From a service station they obtained 40-gallon grease drums, cleaned them and, after punching holes in the bottoms for drainage, filled them with sandy loam. They supplied enough water to bring the soil moisture to field capacity.

They planted the grass seeds in each drum on April 1, 1960, and covered the soil with hay mulch to prevent rapid surface drying. They thinned the seedlings to three to each drum when the plants were three inches tall. When the grass was six inches high, the technicians clipped the plants in the first drum to a height of four inches. They repeated this each time about one inch of grass had regrown. This was to reflect overuse under range conditions. The clipped material was retained in a paper bag marked to correspond to the drum.

Grass in the second drum was clipped to a height of six inches each 21 days. This was intended to represent the effect of rotation grazing. These clippings also were retained. The grass in the third drum was clipped continuously to a height of eight inches each time an inch of new growth appeared. Local technical guides show this as a standard for proper use of buffelgrass.

The grass in the fourth drum was



left unclipped to simulate deferred grazing. It also served as a control drum.

No fertilizer or other soil amendment was added to any of the drums. The plants depended for the most part on rainfall for moisture. During the extended summer drought, however, they were watered twice. The same amount of water was poured into each drum. The "deferred" plants showed a need for water before the other plants.

On October 25, 1960, before the end of the growing season, the drums were emptied and the roots washed to remove the soil. The plants were dried and then were mounted on plyboard. The dried clippings were weighed, packaged in clear plastic and attached on the plyboard in appropriate position. Clipping weights were: "overused" plants, 45 grams; rotation grazing, 85 grams, and properly used, 75 grams. The deferred plants were not weighed.

The display, on view in the SCS office in Benavides, has been useful in acquainting the local stockmen with the principles of proper management of their grasslands. It frequently is a center of interest in rancher meetings, at county fairs and in local banks. The technicians carry photographs of the display for use in discussing with ranchers the way grasslands respond to the various grazing systems under local conditions.

BOOK REVIEWS

The Oregon Desert. By E. R. Jackman and R. A. Long. *The Caxton Printers, Ltd., Caldwell, Idaho. 398 pages. 1964.* $4.95.

THE OREGON DESERT is a hard book to define, as is stated on its dust jacket. It contains more entertainment than reference material, but it has a quotable quality that will stick with a reader for years. Its strongest elements are humor and an enticingly simple, straightforward philosophy.

The stranger to eastern Oregon, the newcomer to the high northwest desert, the person looking for some modern facts and descriptions will find them slow in coming as he reads this book. He'll have to go all the way to Chapter 22, for instance, to obtain a description of things to see in the Oregon desert.

But this is not meant as criticism because THE OREGON DESERT is not that type of a book. The authors have written primarily for those already familiar with eastern Oregon. Their descriptions are as those seen through the memories of two wise old men. As Reub Long says in the final chapter, "The older I get, the better I used to be."

THE OREGON DESERT is exciting, humorous, thought-provoking and it is doubtful if there is another book like it. Most writers of the Pacific Northwest have concentrated on the mountains and lush forests of the coastal belt, but as E. R. Jackman says in Chapter I, "America is suddenly desert conscious." The high desert of Oregon is as large as the state of West Virginia and more than anything else it has what is becoming increasingly valuable in America —space.

The authors write well and their individual chapters fit together perfectly. E. R. Jackman is a retired Oregon State University extension specialist in agronomy and range management. Reub Long is a desert horseman and cattleman from "way back when."

Indians, cowboys, sheepherders, and homesteaders appear throughout the book. So do wild horses, coyotes, deer, badgers, skunks and other desert wildlife as seen first-hand by the authors.

Jackman has two chapters which are particularly enlightening. "Uncle Sam Is Rich Enough to Give Us All a Farm" vividly describes the pathetic attempts to homestead and farm the Oregon desert. With the 102-year old Homestead Law still on the books this statement by Jackman is still pertinent in some western regions, "From society's viewpoint, the worst thing about homesteading was that it was hard on the land. Millions of acres were plowed that should have been left as 'unshorn fields.' "

"Grass Grows By Inches — It Is Destroyed by Feet" is a commonsense discourse on desert range management that should be required reading for all range technicians.

Long's chapters are mostly about horses, but they also contain many delightful and humorous stories about dude wrangling, sheepherding, trapping, farming, moving picture making, packing, and running a pool hall—all by a man who spent his life working at them.

No one who reads THE OREGON DESERT will ever again look at that vast, open country in quite the same way.—*Robert E. Wilber,* U.S. Bureau of Land Management, Reno, Nevada.

The Trail Drivers of Texas. Compiled and edited by J. Marvin Hunter. *Argosy-Antiquarian, Ltd., New York. 1070 pages.* 1963. $37.50.

The historic cattle drives, particularly in western United States, were among the singular folk-epics of early American life. *The Trail Drivers of Texas,* long out of print, includes a record number of personal experiences about trailing cattle to new range or to market. This handsome new edition again makes it possible for modern collectors to own a copy of a rare book on a special phase of pioneer range life.

Since the days of primal herding, cattle have walked themselves to market. Cattle served as portable commissaries to supply meat, milk and hides for armies, explorers, and emigrants. Two volumes of this book present over 1,000 pages which tell the reader how hundreds of lean riders on tough Texas mustangs herded 10 million Longhorns to Kansas railheads, to Northern Plains Indian reservations and to unstocked grassy ranges as far north as the Saskatchewan.

Texas cattle herds had swelled and overflowed the ranges while outside markets had been choked off during the Civil War. Texas cattlemen with millions of unsalable cattle were stone broke during the Reconstruction Period that followed.

After the Civil War when the buffalo in the Northern Great Plains had been exterminated and Indians corralled on reservations and railroads bisected the Great Plains, large herds of bawling Longhorns surged north to new markets and to new grass. It was during this era from 1865 to 1885 that our American folk-hero, the cowboy, became a distinctive entity on the national scene. Today, income from radio, TV, movies, songs, and special clothing, which epitomize the golden era of trail driving and cowboying, bring in more cash per year than was received for the 10 million Longhorns that tramped up the Texas trail in a little over 15 years.

A dedication marker at Doan Store at the crossing on the Red River in Texas gives a boiled-down version of the trail driving objective. The inscription reads as follows:

"IN HONOR OF THE TRAIL DRIVERS WHO FREED TEXAS FROM THE YOKE OF DEBTS AND DESPAIR BY THEIR TRAILS TO THE CATTLE MARKETS OF THE FAR NORTH, WE DEDICATE THIS STONE, A SYMBOL OF THEIR COURAGE AND FORTITUDE AT THE SITE OF THE OLD DOAN'S STORE."

To George W. Saunders, first president of the Old Time Trail Drivers' Association, goes the credit for bringing together the experiences of hundreds who made the trail drives. J. Marvin Hunter, editor of the Bandera, Texas, Press, sorted and edited the maze of scratchy longhand letters full of badly spelled words. Thus was preserved the treasured thumbnail histories of former dusty riders whos hardy mustangs carried them through the untamed ranges where flash floods roared, lightning struck and hostile Indians harassed the drovers.

Range men interested in information on early grazing scenes and grass conditions will find numerous enlightening references. While many drovers were largely concerned with hurrying up the trail to market, others were sharp observers and wrote informed accounts about water resources, vegetation and game. They were alert to the hordes of settlers who homesteaded the ranching country, blocked the route and forced cattlemen to shift west over new northbound trails which by 1890 also were bisected by rails and smothered with homesteaders.

This new 2 volume edition of *The Trail Drivers of Texas* is printed on quality paper and comes in a sturdy slip case. It is a limited edition of 750 copies which will soon be sold and later will be hard to find at the present price. There are numerous photographs of trail drivers and scenes of the ranching country. Included is an excellent table of contents and the index will be a helpful asset to readers who also will enjoy the instructive new introduction by the famous western author, Harry Sinclair Drago, who has a weather eye for intriguing incidents about the West.—*B. W. Allred*, U. S. Soil Conservation Service, Washington, D. C.

Range Research Methods. A Symposium, Denver, Colorado, May, 1962. Division of Range and Wildlife Habitat Research, Forest Service, U. S. Dept. of Agriculture. *U. S. Government Printing Office, Washington, D. C., 20402. 172 pages, 8" x 10½" paperbound, December, 1963.* $1.00.

This bulletin is certainly one that every person interested in any phase of range or wildlife habitat research will want to add to his personal library.

The scope and purpose of the meeting—hence of the bulletin—is set forth in the foreword by Kenneth W. Parker, who points out that while considerable success has been achieved in solving problems of range management through research, progress has been impeded by lack of suitable methodology for measuring soil and plant attributes of the range community and the effects of grazing, fire, logging, weather and other factors on these attributes. Citing progress that recently has been made in the electronic processing of data and in other fields, and feeling that better equipment and methodology for rapid and accurate measurement of the characteristics of the range ecosystem was possible, this conference was called to take a critical look at range research methods. In addition to keynoting the bulletin, the foreword is notable for its interesting thumb-nail sketch of the history of range research in America and in the Forest Service.

The subject matter is organized under five main headings: An introductory session, vegetation measurement and sampling, range site measurement and evaluation, measurement and evaluation of range use by livestock and game, and design and conduct of grazing experiments. Within each of these major categories, from four to six separate papers by a total of 52 contributors is included with a committee report which summarizes and emphasizes the important points developed in the papers and discussions and presents the resulting conclusions or recommendations.

It is unfortunate that space limitation precludes separate discussion of many of the papers. Their excellence clearly justifies such treatment.

An outstanding feature is the manner in which the over-all framework and goals or objectives of the conference were established through two introductory papers by R. S. Campbell and D. F. Costello. The utilization of the vast experience of these two "old timers" to define research policy and philosophy and to outline the range research problem provided an excellent background for the more specific presentations. Other items of interest in the introductory session were an excellent though limited treatment of terminology and definitions which pointed up the need for a comprehensive glossary of range terms, and some timely pointers on the effective use of EDP (electronic data processing) facilities.

The section on vegetation measurement and sampling appears to be a substantial treatment of this subject from both the practical and theoretical standpoints. We were pleased to note that emphasis was placed on the latest techniques, i.e., distance measurement methods of sampling vegetation. Other promising new concepts covered are the use of rating or scoring of pairs or sets of plots in sampling to gain efficiency, and the measurement of forage yield and quality from animal responses.

The second subject division, range site measurement and evaluation, is likewise excellent. It contains the

best treatment of the concept of range site that we have seen. The specific recommendations for further research are good.

The third section, measurement and evaluation of range use by livestock and game, does not quite come up to the standard of the two previous sections from the standpoint of the treatment of the measurement of range utilization with the more general recommendations for future research on this subject. This discussion of the pellet-group method was excellent and contained information on defecation rates for some wildlife species not generally available. The ideas of eliminating the need for utilization measurements through use of rest-rotation grazing on some types of ranges, and of developing electronic instruments for use in vegetation measurement were noted with interest.

With regard to section four, design and conduct of grazing experiments, we admit to being entirely unqualified to comment knowledgeably. It appears to contain previously unavailable material that will be of great assistance in planning future experiments.

The following comments relate to the publication in general. We especially liked the layout with numerous subheadings within papers to facilitate quick reference to specific items. The same applies to the obvious effort to summarize conclusions and recommendations both within individual papers and at the end of sections. Literature reviews appeared to be comprehensive, selective and emphasized current and recent publications. The literature cited, representing over 680 items, is a worthwhile contribution in itself. The typographical and grammatical errors, of which there were a few, were of minor consequence.

The Range and Wildlife Habitat Division of the Forest Service and others who had any part in the development of this publication are to be highly complimented. We recommend it to anyone interested in range or wildlife habitat research.—*Laurence E. Riordan* and *Dean E. Medin,* Research Branch, Colorado Game, Fish and Parks Department, Denver and Fort Collins, Colorado.

Agrostology. By W. Edwin Booth. *The Endowment and Research Foundation, Montana State College, Bozeman, Montana. 222 pages. 1964.* $4.00.

"It is a matter of concern that one of the oldest branches of botany has been given little attention in recent years as to the methods of presentation to the student." Perhaps this opening statement will disturb a number of teachers of agrostology who have been giving much time to the problems of presentation of the subject. Further reading of the preface makes it obvious that the author refers to the total lack of a modern textbook of agrostology for classroom use. This book is an attempt to fill that need. Whether or not it does must be left to the teachers of agrostology. This reviewer's interest is in the value of the book to range scientists and managers.

The outstanding feature of the book is its treatment of grass morphology. This section brings together a great deal of material previously available only in scattered references. Roots, stems, leaves, and inflorescence (including spikelet), and the caryopsis (including seed)—each have a chapter. The structure and development of each of these organs is described. Excellent drawings contribute to an understanding of grass anatomy. Emphasis is given those characteristics which have diagnostic value in grass classification.

One chapter is devoted to the cytology and evolution of the grasses. It provides a brief but lucid discussion of the role of chromosome numbers and particularly polyploidy in grass evolution, adaptation, and taxonomy.

The chapter on grass classification perhaps will not be of particular interest to most range scientists. It briefly develops the history of classification systems leading up to the system proposed in 1961 by Stebbins and Crampton. The system of subfamilies, tribes, and genera developed by these authors is listed without characteristics. The scientific workers who must depend on local taxonomic references or on Hitchcock (USDA Misc. Pub. 200) as field tools in accomplishing their objectives are not given much help. On the other hand, it is fair warning that local taxonomic references are likely to show some marked changes in the near future. This chapter provides a good general view of the subject in case one wants to understand the background for change.

The chapters on nomenclature and on identification (keying) are routine fare in textbooks on plant taxonomy and are useful here only if one wishes to refresh himself on these subjects.

The chapter on grass culture and diseases is limited. The discussion of grass production is very short and will not offer anything new to the range scientist. The section on diseases is more extensive and gives a good general view of the subject.

Although this book is not intended as an encylopedic reference on the grasses, it should be a valuable reference for agronomists and range scientists. The selected bibliography at the end of each chapter provides an excellent nucleus of literature for reference purposes.

The very reasonable price of the book has been achieved by using the lithograph process. This has in no way affected the excellence of the illustrations or the general readability.—*Gene F. Payne,* Dept. of Animal and Range Sciences, Montana State College, Bozeman, Montana.

Roots in the Soil. By Johnson D. Hill and Walter E. Stuermann. *Philosophical Library, New York, N. Y. 162 pages. 1964.* $4.75.

This book, with the subtitle "An introduction to the philosophy of Agriculture," argues for the small family farm as a major resource for a healthy culture. The authors make the point early that both labor and agriculture have been neglected by philosophers and by intellectuals generally. They set out two major contentions: (1) That our complex technological civilization rests upon those who handle the soil and deal with nature's resources. (2) That the chief product of the farm is persons.

Several chapters establish perspective for a philosophy of agriculture. The discussion of "Man and Nature" points out the dynamic and creative character of nature and that man is a part of nature. Certainly ecologists will agree. There follows a brief consideration of agriculture in ancient times, contrasting the early Greek love of the land with the situation under the Greek Empire, under which agriculture withered. Later in Rome, the general

pattern of agriculture was that of a wealthy class using slave labor on large holdings. There was little improvement for the medieval farm worker under the feudal systems of Europe and the Christian religion which practically isolated itself from agrarian activities. Then came American settlement and the Revolution, essentially a war of agrarian discontent and rebellion against colonialism and absentee ownership.

We can skip over the history of the farmer and the government and of agrarian movements in the United States to the concluding chapter "A Humane Program for Agriculture." The reports of the Committee for Economic Development are sharply criticized. The CED, supported chiefly by industrialists, in its 1962 report, advocated a "large scale, vigorous, thorough-going" program of government activities to remove some two million workers out of agriculture in two years, and the government out of agriculture in five. The low-income farmer was to be moved out and given job-training. Hill and Stuermann point out that the CED reports are preoccupied with prices, demand, production, etc. of industrial agriculture, and neglect entirely the preference of farmers for their vocation as a way of life. They stress that conservation programs must have a sense of stewardship and that philosophical and religious postulates need revision to generate respect for those engaged in farm work.

In brief, the authors recommend the rehabilitation of the family farm even at the expense of loss of efficiency. This sounds familiar to those of us who worked with government range and conservation programs 30 years ago. Whether or not one agrees entirely with the authors, there are stimulating ideas here that make interesting reading.—*R. S. C.*

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Edited by Meredith Morris, Charles Terwilliger, Jr., and Graduate Student-Faculty Seminar members, Range Management Department, Colorado State University, Fort Collins, Colorado.

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NEW PUBLICATIONS

SHEEP AND WOOL SCIENCE — This is the new and revised third edition of the book previously known as Sheep Husbandry, by M. E. Ensminger of Wisconsin State College. It is a reference and textbook with questions for study and discussion at the end of each of the 17 chapters. It touches on every phase of sheep and goat raising, from history, breeds, sheep management, range and pasture management, health, marketing, slaughtering, wool, and showing. Eight appendix sections give information on sheep feeds, sales, breed registry, etc. The Interstate Printers and Publishers, Inc., Danville, Illinois, 705 pages, 1964, $8.00.

CHEMISTRY OF THE SOIL—Second edition of American Chemical Society's comprehensive monograph first published in 1955, edited by Firman E. Bear. According to the cover jacket, this comprehensive book, completely revised and updated, gives detailed coverage of the most important chemical aspects of soils, including development, chemical composition, physical chemistry, cation and anion exchange, organic matter, biochemistry, acidity, alkalinity and salinity, trace element content, fixation capacities for soluble plant nutrients, relationships in plant production, radioisotope content, and the chemical and instrumental techniques employed in their examination. The 12 chapters were contributed by soil scientists of international standing, such as Isaac Barshad of California and H. B. Peterson of Utah, to name two from the West. With continually increasing emphasis on range soils and sites, this book should find its way to many of our desks, as expensive as it is. Reinhold Publishing Corp., New York, ACS Monograph No. 160, 515 pages, 1964, $20.00.

BULLETIN DE LA FEDERATION FRANCAISE D'ECONOMIE MONTAGNARDE — 754 pages in French, published by the Administration of Waters and Forests and reporting the 1963 Congress of the Federation at Grenoble. The general theme was international collaboration in studies of the alpine economy. But don't let the word "economy" fool you, there is a great deal about agriculture, pasture, and forage quality. Your Editor will pass the book along to any range school which can use it (first come, first served).

WATER: DEVELOPMENT UTILIZATION CONSERVATION — Papers in this volume were presented at the fifth annual Western Resources Conference, held August 5-7, 1963 at Colorado State University and co-sponsored by the Colorado School of Mines and the University of Colorado. Edited by Roma K. McNickle, the 25 papers are grouped under the topics: Government and Research in Water Resources; Clean Water; Pollution Control; Re-use of Water: A Challenge to the West; Efficiency of Water Management in Western Irrigation; Water for Urban Areas; The State's Role in Water Development; Competition for Water; and Water Policy Issues for the 1960's and 1970's. A statement by Michael F. Brewer of California in the concluding paper is worth quoting: ". . . we will be faced increasingly with a rationing problem in which public policy must facilitate efficient and equitable allocations among competing demands for water." Each of the papers by national authorities is worth a look. The index is a helpful guide to authors and subtopics. University of Colorado Press, Boulder, 244 pages, 1963, $4.50.

NATURAL RESOURCES OF OREGON — An illustrated booklet, featuring a map and guide to outdoor recreation areas in Oregon. Prepared by U.S. Department of the Interior. Government Printing Office, Washington, D.C., 68 pages, 1964, $0.50.

THE INFLUENCE OF MODERN MAN ON THE VEGETATION OF YOSEMITE VALLEY — A publication which compares the present vegetation of Yosemite Valley with that existing in 1851 as depicted by early writings and photographs, and discusses the changes — both man-made and natural—which have occurred since then. One of the striking features in comparing then and now is the increase in trees. Authors Robert P. Gibbens and Harold F. Heady state: ". . . it seems most probable that fire was the major factor in suppressing them (trees) before 1851. Heavy grazing, which coincided with the first widespread establishment of trees, was more an accelerating factor . . ." University of California, Division of Agricultural Sciences, Manual 36, 44 pages, 1964, $1.25.

NEWS AND NOTES

Material from many sources; not necessarily the opinion or position of the EDITOR or OFFICERS of THE AMERICAN SOCIETY OF RANGE MANAGEMENT

Beef Exports

Last May, *Secretary of Agriculture Freeman* signed a cooperative market development agreement with American Meat Institute, acting on behalf of entire U.S. livestock and meat industry, aimed at building sales of U.S. livestock products in Western Europe. The new project will be carried out through joint financing by USDA and U.S. agricultural and trade groups, with USDA's contribution coming from Public Law 480. Countries include United Kingdom, West Germany, France, Italy, Belgium, Switzerland, Netherlands, and Spain, where meat supplies currently are lower than normal and prices to consumers unusually high. A special mission was recently sent by the President to study U.S. beef marketing prospects in Europe. Some 700 head of feeder cattle were shipped from Norfolk, Va. to Genoa, Italy on July 11.

In June, the Secretary announced that beef imports into the U.S.A. are expected to drop during 1964 to about the average level for the 1959-63.

Meat Animal Research

Secretary of Agriculture Freeman said in July that USDA is acquiring 10,000 acres of Federal land in Nebraska as a site for National Meat Animal Research Station. Land, near Clay Center, was site of ammunition depot which Dept. of Defense has closed. The research station will provide working facilities for 45 scientists and about 150 supporting personnel. It will include laboratory-office building and specialized buildings and shops for cattle, hogs and sheep.

BEEF GRADE STANDARDS

In July, *Secretary of Agriculture Freeman* proposed revision of U.S. quality standards for beef, in line with recent recommendations of National Advisory Committee on Cattle as well as several State and national cattlemen's organizations. Major change is de-emphasis of maturity in grading beef from young cattle. Revision would: 1) result in some reduction of marbling requirements for beef in Prime, Choice, Good, and Standard grades; 2) reduce number of maturity classifications from 3 to 2 in these grades; 3) eliminate consideration of 2 degrees of marbling in excess of that now classified as "abundant"; and 4) require all carcasses be graded on ribbed basis only, that is with hind- and fore-quarters separated so carcass ribeye muscle is visible to grader.

Crested Wheatgrass Management

At the invitation of the Bureau of Land Management, experts from several western states held a symposium in Burns, Oregon, on crested wheatgrass management, July 28-30. According to *Howard DeLano,* BLM range management chief in Portland, the Bureau will reseed 113,000 acres to crested wheatgrass in Oregon this year.

Experts from western universities participating in the symposium include *Lee Sharp,* U. of Idaho; *Joseph Robertson,* U. of Nevada; and from Oregon State University *Dillard H. Gates, Charles Poulton,* and *Donald Hedrick.*

Neil Frischknecht of the Intermountain Forest and Range Experiment Station in Utah and *Joseph Mohan* of the Ochoco National Forest in Oregon represent the U.S. Forest Service.

E. William Anderson of the SCS in Portland, and *Arthur Sawyer,* Superintendent of the ARS Squaw Butte Experiment Station, together with BLM range management specialists and others will share technical information about crested wheatgrass.

Sagebrush Webworm

Sometimes a friend, sometimes an enemy, the sagebrush webworm *(Aroga websteri)* has definitely made an impact on Oregon range management since its population explosion last summer. Ideal environmental conditions in 1963 spurred an almost epidemic spread of the insect, according to *Howard DeLano,* BLM range specialist. Field observation this year indicates very little webworm activity. Much of the sagebrush classified as heavily attacked last fall is beginning to show some sign of recovery. Programmed funds will allow limited treatment of areas in which the webworm has destroyed most of the sagebrush and on which the establishment of good perennial grass cover must be obtained by cultural means.

Conservation Awards

Nominations for 1964 American Motors Corporation Conservation Awards will be accepted until October 15. The program annually honors 20 individuals and two non-profit organizations for outstanding effort in conservation of the nation's natural resources.

Ten awards, each consisting of $500 and an engraved bronze plaque, are made to professional conservationists employed by non-profit organizations. Bronze plaques and citations are awarded to an equal number of non-professionals whose conservation efforts are a voluntary expression of good citizenship. Awards of $500 each are made to one national and one local non-profit organization in recognition of achievements in special conservation projects.

Objective is to select winners whose conservation efforts have not received public recognition. Nominations should be submitted by letter to: American Motors Conservation Awards Committee, Room 700, 555 Madison Avenue, New York, New York, 10022.

Personals

George D. Lea, manager of the Bureau of Land Management's Lakeview District, was promoted to Director *Charles H. Stoddard's* staff in Washington, D.C. *Lea,* who has been district manager in Lakeview for the

past two and one-half years, will be in the Division of Resource Program Management.

Robert E. Newcomer transferred from Ogden to McCall, Idaho, in August. Bob has been assigned to the Division of Recreation and Lands since 1961. He will assume the duties of Recreation and Lands Staff Specialist on the Payette National Forest.

George K. Stephenson is new assistant director of Southern Forest Experiment Station in New Orleans. The station was recently reorganized with the Director and five assistant directors to replace the former eight division chiefs. *Steve* will continue in charge of watershed management, forest recreation, range and wildlife habitat research. *Walt Zillgitt* is Director of the Station.

L. D. Love, who retired last spring as research forester for the Rocky Mountain Forest & Range Experiment Station at Fort Collins, Colo., has joined the School of Forestry faculty at Arizona State College in Flagstaff. He will teach range management.

Richard L. Bury, who will teach ASC courses in forest recreation, joined the faculty directly from the forest recreation staff of the Pacific Southwest Forest & Range Experiment Station at Berkeley, Calif.

John H. Ehrenreich has accepted a position as professor of range management at the University of Arizona. He was formerly project leader of range and wildlife habitat research of the Central States Forest Experiment Station, with headquarters at Columbia, Mo. *John* took his undergraduate work in forestry and range management at Colorado State University, and his Ph.D. in plant ecology at Iowa State University. He has authored or co-authored 30 publications. He will do research and teach courses in range management and research methods.

H. B. Passey, SCS, has transferred from Denver to Temple, Texas, P.O. Box 648.

Roy C. Dawson will be assigned to FAO headquarters, Rome, Italy, from August 26 to September 25, returning via Boston where he will participate in an International Conference o nthe Wholesomeness of Irradiated Foods, September 27-30.

W. J. Lucas, Assistant Regional Forester of the Eastern Region, U.S. Forest Service, has been promoted and reassigned from the Philadelphia area to Washington, D.C., as Staff Assistant in the Division of National Forest Administration with duties in the field of recreation management. *Lucas* is a native of South Dakota with 25 years experience in USDA. He is a forestry graduate of the University of Idaho and following his Army service from 1941 to 1946, he served with the Forest Service in Idaho, Wyoming, Utah, and Montana. In April of 1961, Mr. Lucas was named Assistant Regional Forester in charge of Resource Management in the Eastern Region. He is a member of ASRM.

Douglas V. Sellars has been appointed research assistant in range management at the Texas Technological College Research Farm at Amarillo, Texas. He will conduct research into altering ecology of West Texas rangelands under the direction of *Dr. Thadis W. Box.*

Jeff Powell, June graduate in range management at Oregon State University, has been selected for a research fellowship at Texas Technological College, made possible by a grant from the Rob and Bessie Welder Wildlife Foundation, Sinton, Texas. *Jeff* will work toward his M.S. degree on theh effect of brush control on game populations.

FAO announces a vacancy as Agricultural Officer (Pasture Management) P-4. Gross salary $11,400 per annum, plus allowances. Headquarters in Rome. Apply to Chief, Recruitment Section, FAO, Via delle Termi di Caracalla, Rome.

Rosser A. Rudolph

Rosser A. Rudolph, 58, a retired official in the U.S. Bureau of Indian Affairs, died of a heart attack at his home in Arlington, Va. on March 28. He served 28 years with the Bureau, retired in 1962 as chief of range management. *"Tex" Rudolph* was a native of Paris, Texas, graduated from the University of Montana, and worked with USDA several years before joining USDI in 1932. He was Secretary-Treasurer of the National Capital Section of ASRM for several terms.

INTERNATIONAL

International Grassland Congress

IX International Grassland Congress will be held in Sao Paulo, Brazil Dec. 30, 1964 to January 21, 1965. The Secretariat, has already contacted 3500 persons from 107 countries. The Secretariat has received 363 summaries of papers, from researchers of 47 countries.

The technical program has been divided into 21 sections:

1. Genetics and Breeding of Forage Plants.
2. Establishment and Early Management of Pastures.
3. Ecology and Physiology of Grasslands.
4. Production and Distribution of Forage Seed and Vegetative Propagation Material.
5. The Role of Grasslands in Soil and Water Conservation.
6. Forage Conservation and Utilization.
7. Macro and Micro-elements in Plant Nutrition.
8. Nutritional Deficiencies of the Grazing Animal.
9. Forage Nutritive Value, Intake and Metabolism of Ruminants.
10. Cultivated Pastures and their Management for Meat, Milk, Wool and Hide Production.
11. Intake and Behavior of the Grazing Animal.
12. Climatic Factors in Growth of Pastures.
13. Nitrogen Cycle in Pastures; the Role of Legume and Nitrogen Fertilizers.
14. Problems of Diseases, Insects, Weeds and Poisonous Plants in Forage Production.
15. Survey, Improvement and Management of Natural Vegetation.
16. Utilization and Management of Cactaceous Plants in Arid and Semiarid Zones.
17. Experimental Techniques in Pasture Research.
18. Soil Fertility and Crop Rotation in Relation to Grassland Production.
19. Economics, Planning and Mechanization of Grasslands.
20. Pasture Utilization and Grazing Management.
21. Miscellaneous.

Israeli Society of Range Management

The fourth annual meeting of the revived Israeli Range Management Society was held March 29-30, 1964, in Tel-Aviv. It was attended by 60 ranchers, extension, conservation and research people. The first day was dedicated to the following papers:

Section A—Grazing and Improvement.

Grazing records on two ranches in the Northern Negev. *(I. Katsir).*

Grazing records in some Upper Galilee settlements *(M. Weitz).*

Perennial grasses for use on submarginal farmland under Mediterranean conditions. *(R. Peleg).*

The experience with shrubby saltbush in the Northern Negev. *(Y. Ofer).*

Section B—Range economics

Integration of dry farming and grazing in a 8-12 inches rainfall region — Northern Negev. *(H. Zaban).*

Fattening steers on range land *(D. Levy).*

Section C.—Range Research

Use of water to ensure success of establishment of shrubby saltbush in a dry year. *(N. Tadmor).*

Annual salt content cycle of shrubby saltbush. *(N. Tadmor).*

Calibration of experimental pastures at the Karei-Deshe Expt. Range. *(N. G. Seligman).*

Survey of the effect of chemical fertilization on the vegetation of a number of range habitats. *(N. G. Seligman* and *Y. Ofer).*

Control of Prickly Burnet (Poterium Spinosum) by serial spray of 2,4-D. *(N. G. Seligman* and *I. Katsir).*

Subteranean clover on various Israeli soil types. *(Y. Katzenelson).*

Growth cycle of some maquis shrubs. *(M. Weitz).*

R. M. Love, University of California Dept. of Agronomy was a guest speaker.

On the second day an excursion to the Mivchor seed farm and the Shikma watershed development project was held. The good rains this year helped to provide lush, green pastures that put everyone in a most optimistic mood.—*Jacob Katsir,* Secretary.

RANGE STUDENT ROUNDUP

UNIVERSITY OF ARIZONA

Officers for the school year were: *Dick Smith,* Chairman; *Dave Godfrey,* Vice-Chairman; *Art Tiedemann,* Secretary-Treasurer; *Dave Little,* Corresponding Secretary. Membership for the year totalled 41 including faculty, staff, and affiliated department members.

Guest lectures at monthly meetings included a report on the 1963 Range Management Field Trip by *Professor Schmutz;* range problems of Western Australia by *Dave Wilcox;* research and teaching of range management in Venezuela by *Don Johnson;* development of ground water supplies by *Dr. John Harshbarger;* and range management problems on National forests by *Forest Supervisor Clyde Doran.*

Other activities included participation in Aggie Day events for the College of Agriculture; attended the Spring Field Day of the Watershed Management Department; co-sponsored the National Science lecture on aerial photography given by *Dr. R. N. Colwell;* supported and participated in the Winter meeting of the Arizona Section on "What is Range Management"; and cooperated with the Aggie Council in sponsoring other events in the College of Agriculture.

Aggie Council representatives for the Chapter were *Gerry Williams,* Senior Representative, and *Dave Godfrey,* Junior Representative.

Eldon Buckner received the 1963 Range Management scholarship award of $150 presented each year by the Arizona Section to the outstanding student in Range Management.

Our final meeting of the year was a cookout held at the Mount Lemmon recreational area. Officers elected at this meeting for the 1964-65 school year included *Gerry Williams,* Chairman; *Art Tiedemann,* Vice-Chairman; and *Bob Bales,* Secretary-Treasurer. *Richard Hawkinson* was appointed Corresponding Secretary.

U. of Arizona Chapter cookout, Mount Lemmon Recreation Area.

UNIVERSITY OF CALIFORNIA

Range Management at the University of California is administered in a coordinated program which combines work on both the Berkeley and Davis campuses. Graduate and undergraduate enrollment in the program numbered 27 during the 1964 spring semester.

In January 1964 *George M. Van Dyne* received a Ph.D. at the University of California, Davis. The title of his thesis was "Forage intake and digestion by cattle and sheep on common dry foothill annual range." He has taken a position in ecological research with the Oak Ridge National Laboratory, Oak Ridge, Tennessee.

The University of California, Berkeley and Davis, graduated six men with the degree of Master of Science in Range Management in 1964. *Michael S. Adams* is employed as a Range Conservationist at the Riverside, California district office of the Bureau of Land Management. *Frank P. Guerrero* has accepted a position as Laboratory Technician in the Department of Agronomy, at Davis, and will continue toward a Ph.D. in ecology. *William J. King* is assisting the Range-Soil Fertility Project at the U.C. Range Field Station at Hopland as a Laboratory Technician. *William T. Pyott* has ac-

cepted a Research Assistantship with *Professor C. E. Poulton,* Oregon State University in studies of sagebrush range ecology and will engage in a graduate program leading to a Ph.D. *Peter Stent,* whose interest is in ranching as a business, will continue work toward a Master's Degree in Business Administration. *Vernon Mayes* is planning additional graduate studies in range at Utah State University, Logan, in the fall.

The following men received the Bachelor of Science degree in range management, *Gary A. Lange, Raymond J. Nelson, William S. Tanaka,* and *Stephen E. Willeford.*

UNIVERSITY OF NEVADA

Several students in Range Management completed their formal education at the University of Nevada in 1963-64.

Ted Knowles graduated at the end of the fall semester and is now working for the U. S. Forest Service in Paradise Valley, Nevada.

Donald H. Heinze completed his Masters this past spring after doing his problem on herbaceous undesirables on crested wheatgrass seedings. The project was in cooperation with the U. S. Forest Service and Bureau of Land Management. *Don* presented his problem to the Nevada Section of Range Management at the meeting in Fallon, February, 1964. Next year *Don* will work for the University of Nevada in co-operation with the Bureau of Land Management on a watershed study.

Allen D. Bruner, graduate student for the past 2½ years, worked as a graduate research assistant for the Division of Plant Science. In February, *Allen* joined the Crops Research Division of the Agricultural Research Service. He has been working with *Dr. R. A. Evans* and *Dr. R. E. Eckert* on range weed and revegetation problems throughout the northern half of the State.

Alvin R. James hopes to finish his graduate work this fall. *Alvin* carries a full load as a student and is also treasurer of the Tribal Council of the Pyramid Indian Reservation. He is also chairman of the recreational development. *Alvin's* Masters problem is very worthwhile; it is the development of a range management plan for the Reservation.

This past year the *Fleming* Range Management Scholarship was won by an undergraduate, *Pete Etchamendy.* Pete plans to spend the summer working on a U. S. Forest Service Range Analysis Crew along with another undergraduate, *Barry Davis.*

Tim Thompson plans to work on a range analysis crew for the Bureau of Land Management in Ely, Nevada.

This past winter, Nevada sent a Plant Judging Team to the National meeting of the American Society of Range Management at Wichita, Kansas, coached by *Dr. Paul T. Tueller.* The members were *Pete Etchamendy, Larry Doughty, David Everett* and *Barry Davis.*

The final event of the year, the annual range field trip, took place the first week of June. It was especially enjoyable and profitable because nine students from Africa and South America joined the trip to northeastern Nevada.—*Barry Davis.*

NEW MEXICO STATE UNIVERSITY

Twenty-three interested students at New Mexico State University organized a student chapter of the New Mexico Section of ASRM during the fall semester of 1963.

The twenty-three charter members elected *Elmer Walls,* President; *Donnie R. Sparks,* Vice President; *Daniel C .B. Rathbun,* Secretary-Treasurer; and *Dr. Carlton Herbel, Dr. Rex D. Pieper* and *Prof. K. A. Valentine,* Sponsors.

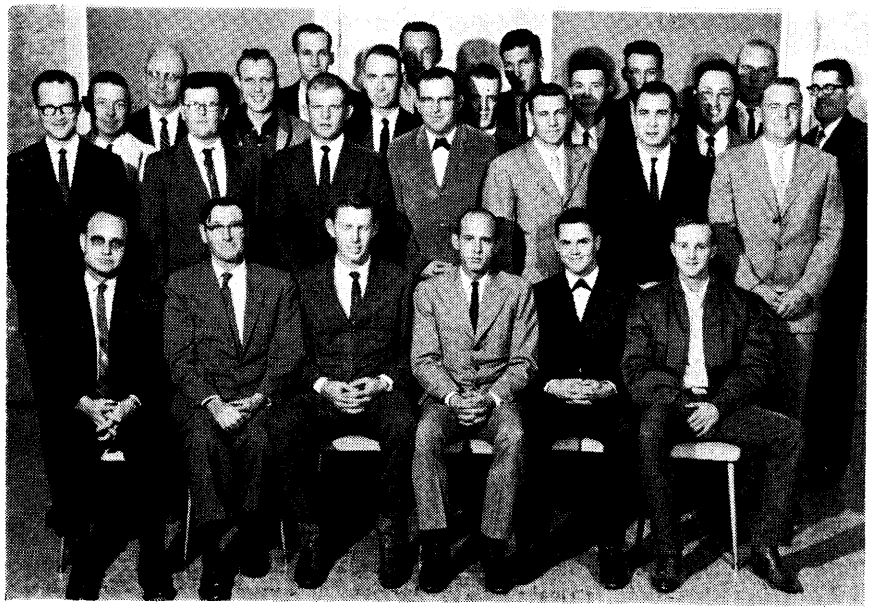
Meetings during 1963-64 were programmed with educational interests in mind by the Program Chairman and Corresponding Secretary, *W. J. Halliday.* Among the featured speakers were *Dr. Floyd Kinsinger* of the Bureau of Land Management who spoke on "Career Opportunities with BLM," *Mr. Fred H. Kennedy,* U. S. Forest Service, on a "A Career with the Forest Service," *Mr. Robert Ronald,* Caterpillar Tractor Co., who showed a movie "Mechanical Means of Brush Eradication," *Mr. Frank Abercrombie* of USAID who showed slides and commented on range conditions and management practices in Somaliland and Nigeria, Africa. *Lee Buffington,* a graduate student from South Dakota, presented findings pertaining to his M.S. Thesis on Vegetation Changes on the Jornada Experimental Range. *Prof. K. A. Valentine* administered an ecological quiz called "Crusade for Rangeland Restoration" which was prepared by *Dr. Joseph F. Arnold,* Director of Watershed Management Division, Arizona State Land Department.

Newly elected officers for 1964-65 are: *Donnie Sparks,* President; *Bob Baker,* Vice President; *Douglas Boston,* Sec.-Treasurer; *Cecil Esslinger* and *Don Bell,* Ag Council represcntatives.

The Chapter had 10 graduating seniors and 2 advanced degrees in 1964.—*Bill Halliday*

OREGON STATE UNIVERSITY

Four field trips and two types of range management short courses highlighted 1963-64 at Corvallis. With enrollment on the upswing,



Student Chapter, ASRM, New Mexico State University

19 undergraduates and 11 graduate students, under the direction of *Drs. Poulton* and *Hedrick,* completed an interesting year.

Three Forest Service men, *Robert Bamburg, Alfred Meyer* and *Robert Northman,* attended selected range management and related classes during Fall term as part of their in-service training.

On the first field trip, *Dr. Hedrick* and 16 students traveled to the University-owned 2000-acre *Hall* Ranch, in eastern Oregon. The fall vegetation of open grass, shrub, and tree types were inventoried and checked for condition and utilization.

On the second trip, *Dr. Poulton* and 11 students made a winter visit to the Crooked River National Grasslands of Central Oregon. The class studied crested and beardless wheatgrass seedings and sagebrush control under the guidance of *Joe Mohan,* U. S. Forest Service.

Dr. Poulton and 6 students went to the *Hall* Ranch to obtain data for spring management planning.

On the last spring trip, *Dr. Poulton* and 10 graduate students went to the Squaw Butte Experiment Station in central Oregon, where range ecology principles and applications were studied. Mapping range land on a high intensity, habitat-type basis was tested. Vegetation from the shadscale through the ponderosa pine zones was studied. The purpose was to learn how to develop and interpret needed information on range ecology.

Early in the fall, a get-acquainted dessert brought the range students, their wives and the staff together at the home of *Dr.* and *Mrs. Poulton.*

Joe Mohan, U. S. Forest Service, shows students how to rate a new range seeding on the Crooked River National Grassland.

The year's social activities were concluded by a Mother's Weekend party for range students at the new home of *Dr.* and *Mrs. Hedrick.*

SOUTH DAKOTA STATE UNIVERSITY

The 1963-64 school year was an active one for the range management majors at SDSU. Beginning on August 3, 1963 three weeks were spent in the Black Hills and surrounding area with *Prof. Bob Gartner* on range surveys. Immediately after this session a three week tour of South Dakota, Wyoming, northern Colorado and western Nebraska was made with *Prof. J. K. Lewis* studying the relationship of range vegetation to environmental gradients, range management and range livestock production problems. Both sessions were interesting and educational but strenuous. The endpoint of the six weeks was not reached without considerable relief being felt by all concerned.

Four seniors were sent to Wichita, Kansas for the Range Plant Identification Contest held in connection with the annual meeting of the ASRM. Team members were *Norman Bower, Douglas Salverson, Bruce Birkeland* and *Frank O'Neill.* This meeting was one of the high points of the year.

The classes in range improvement and range management planning made an extended tour in May, visiting four ranches and a grass seed cleaning plant with several other stops to observe range improvement practices in central and northwestern South Dakota. The students felt this was one of the most successful tours they had been privileged to attend.

Three range management majors finished their B.S. degree requirements at the end of the six weeks field session last summer. These graduates and their occupations are: *Wilton Peterson,* BLM, Miles City, Montana; *Ken Barrows,* ranch near Faulkon, South Dakota; and *Myron Enevoldsen,* graduate school, SDSU. *Frank O'Neill* graduated at the end of the fall semester, 1963, and is employed by the BLM in Prineville, Oregon. June 7 graduates and their occupations are: *Waldean Asheim,* BLM, Miles City, Montana; *Bruce Birkeland,* SCS, Chamberlain, South Dakota; *Norman Bower,* graduate school, University of California; *Merril Hass,* ranching; *Douglas Salverson,* BLM, Lewiston, Montana.

Officers of the range management club and the SDSU Chapter of ASRM for 1963-64 were: *Douglas Salverson,* president; *Norman Bower,* vice president; and *Bruce Birkeland,* secretary-treasurer. Activities included seven lectures on various phases of the management of range and other renewable natural resources by college staff, technicians from various government agencies and a student from a ranch in Mexico. The club also prepared a booth for the Little International Livestock Exposition held annually on the SDSU campus. New officers for 1964-65 are: *Gary Gerth,* president; *Dave Fischbach,* vice president; and *Terry Wilson,* secretary-treasurer. *Tex Lewis* is again lending his able and much appreciated assistance as range club advisor. Reports are that next year will be a banner year for enrollment so we are looking for an increase in range majors also.

Beginning in September *Prof. Bob Gartner* will begin a two year leave of absence to work on a Ph.D. degree in range management at the University of Wyoming. *Bob* will certainly be missed at SDSU.—*Bruce Birkeland.*

TEXAS TECHNOLOGICAL COLLEGE

The Texas Tech Chapter, ASRM, completed a successful first year under the capable direction of its officers: *Gary Stone,* President; *Bob Whitson,* Vice-President; *John Malechek,* Secretary - Treasurer; *Dan Rodgers,* Councilman; and *Thad Box* and *John Hunter,* advisors.

Program for the year included the bringing in of off-campus speakers, assisting with the host activities for the Texas Section annual meeting, professional discussions, and regular chapter meetings. Several committees were active in planning long term projects. In addition, Tech chapter members served on key committees for the Texas Section.

Membership in the Tech Chapter was maintained at about 50, including most of the range students. Several Tech students received scholarship honors during the year. *Ken McAdams* and *Tommy Welch* were awarded *Hunter* Scholarships in Range Management. *Bev Herndon* and *Darrell Ueckert* received scholarships from the college. In addition,

Tommy Welch was awarded an undergraduate grant from the National Wildlife Federation.

John Malechek was named the outstanding upper division student in range management at the December meeting of the Texas Section. *Darrell Ueckert* was named the top lower division student at the same meeting.

Graduate students receiving scholarships, assistantships, and grants during the year were *Dan Rodgers* of East Texas State College, Post-Montgomery Fellowship in Range Management; *Dean Chamrad* of Texas A & I College, the *Welder* Wildlife Foundation Fellowship in Range Management; *Russell Pettit* of Ft. Hays State College, the Experiment Station Assistantship; and *Ed Robertson* of Texas Tech and *Richard Dee* of Utah State University, the Texas Tech Research Farm Grants. *Doug Sellars* of Oklahoma State and *Jeff Powell* of Oregon State joined the chapter during June.

Tech Chapter members accepting assistantships for graduate work at other institutions were *John Malechek,* Colorado State University; *Dan Rodgers,* Utah State University; and *Ken McAdams,* University of Nevada.

Dr. Joseph L. Schuster joined the range management staff in January. He is a Texas A & M-Colorado State hybrid with teaching and research experience at the Rocky Mountain and Southern Forest Experiment Stations. He came to Texas Tech from the Southern Station where he was doing range and wildlife habitat research. At Tech he will teach advanced courses in range management, research methodology, and vegetation influences.

Dean Gerald W. Thomas, charter Tech Chapter member and advisor, left in January for a six-month's temporary assignment with the office of Cooperative Experiment Stations, USDA, in Washington, D.C.

Graduates at spring commencement included *Doyle Caskey, Norman Harbert, John Liles, John Malechek, Bill Meador, Ken McAdams, Robert Neeley,* and *Gary Stone. Ed Robertson* finished requirements for his masters degree. Of those finishing, four will go into ranching, two to graduate school, and one each into agricultural journalism, ranch consulting, and Soil Conservation Service work.

Officers for 1964-65 were elected at the last meeting. They are *Tommy Welch,* President; *Bob Whitson,* Vice - President; *Darrell Ueckert,* Secretary-Treasurer; *Winfred Bauer* and *Rhett Johnson,* Council members; and *John Hunter, Joe Schuster,* and *Thad Box,* advisors.

UTAH STATE UNIVERSITY

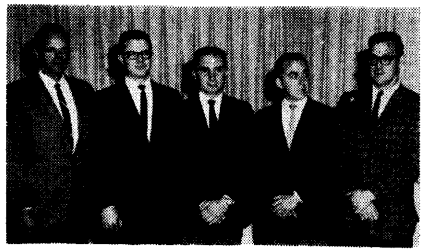
The Utah State University Student Chapter is particularly proud to report two major accomplishments. First, the school's plant judging team placed first in the plant identification contest at Wichita, Kansas. The team was made up of *Julian Anderson, Harley Greimen, Dick Hall, Von Swain,* and *Glade Quilter*—all of whom are active Society members. Individual placings in the competition found *Dick Hall* in the No. 1 spot and *Julian Anderson* in No. 3, with all team members placing in the top eleven. Second, the Student Chapter's membership for 1963-64 nearly doubled.

During Utah State University's Conservation Week, which is jointly sponsored by the Forest, Range, and Wildlife organizations, another Student Chapter member received honors when *Dave Hess* was awarded the *Son of Paul* award for outstanding Scholastic achievement and leadership abilities.

During the past year considerable time has been spent by Student Chapter members in the formation of a Forest Range, and Wildlife Council at U.S.U. The goal of this newly established group is to promote better cooperation and understanding between the various natural resources management students during school and in future years. Student Chapter member *Stan Miller* was elected President of this new organization.

Regular Society activities included the annual Fall and Spring Cook-Outs, and monthly talks by conservation leaders of the area.

To terminate the activities of the school year the following men were elected as Student Chapter Officers: *Lew Campbell,* Chairman; *Joe Dunford,* Vice Chairman; *Larry Morrow,* Sec. Treas.; *Dick Farrar,* Board Member; *Wendell Gore,* Board Member; *Dr. J. B. Grumbles,* Advisor.



1964 Judging Team from the University of Wyoming. Left to right are: Dr. Herbert G. Fisser, coach, John Mooney, Robert Currier, Charles Wilkie, and Ray Sherfey.

UNIVERSITY OF WYOMING

As in years past, conservation students gathered in Jackson Hole during the second week in June. Two selected students from each of Wyoming's 23 counties studied range management under *Alan Beetle* and *Morton May,* soils with *Harold Bindschadler,* watershed with *Oscar Barnes* and wildlife with *George Kaminski.* The Wyoming Agricultural extension service manages the camp. Financial support comes from Wyoming Soil Conservation districts and from county 4-H councils.

The University of Wyoming was once again represented at the national meetings in Wichita by a judging team consisting of second-timer *Charles Wilkie,* and new contestants, *Robert Currier, Ray Sherfey,* and *John Mooney.* All are seniors. *Charles Wilkie* is going on to graduate work at the University of Nevada, *Robert Currier* is going to work for the Bureau of Land Management at Las Vegas, Nevada, and *John Mooney* will be working for the U.S. Forest Service. They held up Wyoming's record of never failing to participate and took fifth place. Funds to support the range judging team were raised by holding a fall turkey shoot.

Elected officers of the Wyoming student chapter are President, *Myron Wakkuri,* vice-president *Gary Blinco,* and secretary-treasurer *Robert Sorenson.* In an all-University election *John Workman,* senior in range management, was chosen to represent the agriculture college as campus senator. In this capacity he replaces another range student, *Charles Wilkie.*

Wyoming's range management section now has three additional members who have pledged Alpha Zeta (National Agriculture Honorary). These include *John Mooney,*

Ron Jones and *John Workman. Myron Wakkuri, Larry Cary* and *Charles Wilkie* are present members.

Graduate students ranks will be thinned as *Robert Hyde* and *James Nichols,* both from Fort Hays, Kansas, receive Ph.D. degrees, but will be replaced as *Francis Jozwick* comes to Wyoming from Washington State College and *Robert Gartner* from South Dakota State College. *Larry Robinson* and *Paul Bergman,* both from Fort Hays, Kansas, and *James Flesland* from North Dakota State College will also be joining our graduate student ranks soon. Other relatively new graduate students include *Ross Wight* from Utah State College, *Edward Cattrell* from the University of Wyoming and *Larry Cary* from the University of Wyoming. At the M.S. level degrees are going this spring to *Richard Langston* from Sul Ross, Texas, *Robert Hamner* from Oak Forest, Illinois, *Kieth Severson* from Isle, Minnesota, and *Webster Jones,* a local student.

The range management club again sponsored several picnics on Pole Mountain in the Medicine Bow National Forest. These picnics included the members of the range club and were open to the agriculture college students.

A ten-day field trip climaxed four years of agricultural study for 24 Wyoming University students. The future range and ranch managers visited experiment stations and field research facilities in New Mexico and Mexico. Stopping points included the Jornada experimental range near Las Cruces, New Mexico, and La Campana near Chihuahua, Mexico. The trip is part of University course work in field applications of range management techniques. The students were all majors in animal and plant science divisions of the College of Agriculture. They were: *James Blackstone,* Cody; *Jose Coloma,* Quito, Ecuador; *Dale Haefele,* Douglas; *Edwin Hall,* Bassett, Nebraska; *J. R. Heifner,* Newcastle; *Hans Hanson,* Lovell; *Robert Hamner,* Laramie; *Richard Herr,* Millersville, Pennsylvania; *Patrick Herring,* Encampment; *Stephen James,* Kimball, Nebraska; *Gary Kleinschmidt,* Worland; *John Lewis,* Meeteetse; *C. T. Madsen,* Buffalo; *William Mueller,* Cheyenne; *F. R. Nadig,* Stockton, Illinois; *Martin Nelsen,* Cody; *R. Schmachtenberger,* Laramie; *Kieth Severson,* Laramie; *William Stahly,* Laramie; *Edward Thompson,* Sturgis, South Dakota; *Myron Wakkuri,* Elk Mountain; *Charles Wilkie,* Marsland, Nebraska; *John Workman,* Sheridan; *Alvin Young,* Laramie.

Paul Stratton, Wyoming University animal science division head, *Archie Reid,* Wyoming University Plant Ecologist, *Morton May,* Range Management specialist, and *Alan Beetle,* Wyoming University range management head, travelled with the students.—*Robert Sorenson.*

WITH THE SECTIONS

ARIZONA

The Section planned its summer meeting in Show Low August 5 to 7, as a joint session with the Arizona Cattle Growers. The agenda included a tour of the Cibicue Project, arranged by the Bureau of Indian Affairs.

The third annual Youth Conservation Camp was scheduled, first session, July 19 through 25; second session, July 26 through August 1. The site was at the Snow Flat Boy Scout Camp on Graham Mountains. The Camp was under the direction of *Barry Freeman* and *Ray Weick* of the University of Arizona Extension Service. Each session had 50 boys, ages from 15 to 21. The purpose of the camp is to educate boys in the area of wise and proper use of all our natural resources. This is a learning camp, and not a play camp. Boys that attend have expressed interest in the out-of-doors. They are from both city and country. The only prerequisite is that they have an interest in learning about conservation.

IDAHO

The Section planned its annual summer tour in the Medicine Lodge area near Dubois. The Lyman Richwine Chapter was to host the tour. The Southern Idaho and Southwestern Idaho Chapters sponsored a tour on June 12. The group visited the cheatgrass experimental area near Bliss and several revegetation projects in eastern Owyhee County.

NEBRASKA

Three events highlighting range management will take place during mid September in or near Alliance. A tour of the Scotts Bluff Experimental Range has been arranged for Thursday, September 17. The annual meeting of the Section will be held Sept. 18 at Alliance, followed by the State Range Judging Contest on Sept. 19. The Sandhill Horse Racing Meet will be in progress on these dates.

Members of the planning committee developing the 1964 range judging contest are *Bill Schnurr, Howard Watson, Ken Ware, Bob Gaston,* and *Don Miller. Chairman Miller* and his committee have been making additional committee assignments. Many Nebraska Section members will be called upon to help with the contest.

NEVADA

Austin, Nevada was the locale for the annual spring field tour on June 18 and 19. In spite of inclement weather the preceding 3 days, about 40 people attended. Included were 10 A.I.D. foreign technicians studying range management at U. of N. under *Dr. Joe Robertson.*

Thursday afternoon was spent observing Forest Service reseedings southwest of Austin. Discussion leaders were *Archie Murchie, Sam Warren* and *Bob Bobek.* All sites visited had excellent stands of crested wheatgrass although individual plants lacked vigor. Seeded

Nevada Section members on spring tour observing check dam and siltation basin on Willow Creek Mountain Meadow Restoration Project.

areas were in long narrow strips between the BLM land in the valley and the steep slopes of the mountain ranges. It was pointed out that rabbits from adjacent sagebrush areas cross the narrow seeded areas and continually utilize the crested wheat, thus reducing vigor. Poor soil fertility may also contribute to low has been attempted, but for good vigor. A rabbit poisoning program results, an areawide or weekly treatments would be necessary.

Friday the group observed research work of the Agricultural Research Service in cooperation with the Bureau of Land Management, University of Nevada, and the Nevada Fish and Game Commission. At the Willow Creek Mountain Meadow Restoration Area, *Jim Yoakum* and *Jim Schalnus* of the BLM and *Merlin McColm* of the Nevada Fish and Game Commission discussed the development of the cooperative work and the history of the project. *Dr. Dick Eckert* related some of the vegetative work in progress including studies to find the best adapted species, production, quality, and composition changes in forage due to fertilization and iris and sedge control. Hydrological work includes studies on rate of silt deposition in the stream channel, peak water flow, soil moisture depletion, and height and fluctuation of the water table.

Friday afternoon the tour proceeded to the Italian Canyon area. *Jim Schalnus* gave the history of some of the successful and unsuccessful seedings. On one seeding failure, cheatgrass was quick to invade and dominate the site. *Dick Eckert* showed the group through an exclosure with research on cheatgrass control and seeding. Experimental work gave tour members an opportunity to make comparisons between: establishment and growth of crested and intermediate wheatgrasses, fall and spring seedings, pre-and post-emergence herbicides, and chemical and mechanical control of cheatgrass.

NEW MEXICO

The $250 scholarship of the Section was awarded to *Terrill W. Schurr,* a graduating senior at Manzano High School in Albuquerque. *Terrill* plans to study range management at New Mexico State University.

Twenty-four sons, daughters, wives, guests and members of the Society rode into the Pecos Wilderness Area on Saturday, May 16. *President A. J. Garner* proved a reliable guide and escorted the group through the snowbanks to Stewart Lake. *Wes Adams* of Mountain View Ranch, aided and abetted by *A. J.* provided coffee for the group's lunch. After spending a leisurely two hours at the lake, the riders returned.

Coming events for the Section include the Las Cruces Tour in October and the Annual Meeting at Albuquerque in December.

PACIFIC NORTHWEST

Over 135 individuals, including members from Oregon, Washington, British Columbia, California, Nevada and Lake County, Oregon residents participated in the Section's summer range tour June 18-19. The tour, hosted by the South Central Oregon Chapter, Lakeview, was made in buses, with stops to view range improvements and improved forage on public and private lands, game range studies and livestock ranching operations. *Bill Moser* and the hard-working committee arranged for coffee stops, buckeroo breakfast, banquet and special programs for lady guests. The banquet, held in the famous Indian Village Restaurant, attracted over 160 guests and featured an Indian style show with garments over 100 years old.

The Inland Empire Natural Resources Youth Camp was held June 14 to 20 at Camp Heyburn on Lake Chatcolet, near Coeur d'Alene, Idaho. The PNW Section of ASRM co-sponsors this camp with the Soil Conservation Society of America and the Society of American Foresters with active participation by the Idaho and Washington Agricultural Extension Services. This camp annually attracts an enrollment of between 70 and 80 boys from Washington, northern Idaho, and British Columbia. ASRM members on the camp committee include *Ben Roche,* Chairman of instruction, and *Harold Beeman,* Secretary-Treasurer. The outstanding student in range will receive an expenses paid trip to the PNW Section's winter meeting.

The Oregon Youth Range Camp—sponsored by the PNW Section was planned for August 3-8 at the Lake Creek Guard Station. *Bill Moser* was to be camp boss and *Dillard Gates* was to arrange the program. Winter Meeting is planned for Wenatchee, Washington, November 16-17. The 1965-Summer Tour is scheduled for British Columbia.

SOUTH DAKOTA

On June 22 about 75 people attended the range tour in the Custer District of the Black Hills National Forest, under the guidance of *Don*

Nebeker, District Ranger. Excellent range improvement from rest-rotation grazing was seen. An area sprayed with 2-4-D to kill fringed sagewort had changed, with the spraying and 2 seasons deferment, to an excellent stand of western wheatgrass. It appeared that at least a 98% kill had been achieved. This was an early spring spraying when the plants were about 3 inches high.

We also saw range pitting which had worked well, and one of the "tin roof", asphalt-paved runoff area stock-water developments which are providing dependable stock water in the hills.

The group also visited a stock-water pond on *Bill Krueger's* ranch treated with S-13 soil sealant. A hard rain had occurred at the time of treatment and prevented any definite conclusions as to how successful this chemical will be.

SOUTHERN

Vinse Duvall and *Harold Grelen* were host to 27 SCS technicians at the Palustris Experimental Forest on May 19. The group enjoyed an excellent tour to observe the range research being conducted there. The number and size of calves amazed those who were paying their first visit. Nine Section members were included in the group.

A group of ranchers and SCS technicians toured the Monreve Ranch near Indiantown, Florida on April 15. The manager, *Dick Kelley*, conducted the tour which showed their wintering program, herd management and range improvement. This is one of the outstanding range-pasture livestock operations in the Southern Section. Calf crops have averaged well over 90% for the past six years. Weaning weights average 550 lbs. Those on the tour agreed that Monreve operation exemplifies the ultimate in the management of forage resources and animal husbandry.

Two Section members, *President Hank Leithead* and *W. C. Young* were transferred to Fort Worth, Texas in a re-alignment of SCS Washington-Field assistance to States. Both will retain their membership in our section. They will work the same area as in the past, plus the states of Texas and Oklahoma. They assumed the additional territory on July 1.

TEXAS

The 1964 Section Field Meeting was held at the Big Spring Field Station on August 5. The morning tour of the Station covered work on grass evaluation. The afternoon session included discussions by *Dr. H. O. Kunkel*, Texas Agric. Expt. Sta.; *"Bud" Smith*, SCS; *Wayne McCully*, Expt. Sta.; *J. E. Box*, Supt. Big Spring Station, and *Rex Johnson*, ARS.

The 1964 Youth Range Camp was scheduled for July 27-August 1, at the A&M Adjunct, Junction. Thirty boys, 15 each from 4-H and FFA, were scheduled to participate. Range Camp Committee included: *G. O. Hoffman* and *B. J. Ragsdale*, Co-Chairmen, *John Hunter, Don Huss, Rev. Joe Fasel, Obert Sagebiel, Durwood Ball*, and *Valton Hoffman*. *Valton* is a former range camper, now serving as Assistant County Agent for Potter County.

UTAH

The first Utah Section Range Management Scholarship was awarded to *James Peterson* who will be a senior in 1964-65, as announced by *Dr. L. A. Stoddart*.

The Section held its first field tour of 1964 to view range research at the Benmore Experimental Range on June 12. Trail Boss was *Karl Parker*, USU Extension Service, with assistants *Howard Clegg* and *Bob Nielson*. *Neil Frischknecht* and *Lorin Harris* explained management of crested wheatgrass. Steak barbecue lunch was garnished with words of wisdom from *Joe Pechanec*, Director Intermountain Forest and Range Expt. Sta.; *Kenneth Hill*, Assoc. Director USU Agric. Expt. Sta.; *Howard Clegg; F. C. Koziol*, Supervisor, Wasatch National Forest; and *Laurence Sharp*, Vernon Cattle Association. *Wayne Cook* followed up with suggestions about additional species and techniques to obtain better livestock distribution from spring range.

WYOMING

The Summer Range Tour was held on July 10-11. The group drove to the *Palmer Hegge* ranch to observe pitting, reseeding terraces and dikes, strip cropping, water development and results from deferred and rotation grazing.

Lunch was furnished by Farmers-Ranchers Co-op, Belle Fourche, South Dakota, and Bobers Seed House, Rapid City, South Dakota. Coffee by *Pete Smith*, Supt., Ranch A Fish Research Station, Beulah, Wyoming, where their experimental fish breeding work was explained.

The tour then proceeded to Aladdin, Wyoming, where on the *R. S. Hutchinson* Ranch the ARS—Extension Service—and Redwater SWCD, operating out of U.S. Experiment Station, Newell, South Dakota, have interesting range plots on forage yield under different types of management, fertilization, etc. Thence they went to the top of the Bear Lodge Mountains to thinned timber stands on the Dungey Ranch and Forest Service thinning, reseeding management practices. The discussion will be led by *Herman Ball*, Ranger, Black Hills National Forest.

The Section had supper and a short meeting at the Royal Club, Beulah.

Saturday morning, the group met at Devils Tower National Monument, for a look at overgrazed (prairie dogs) and non-grazed range. Then for a tour of leafy spurge infestation on Belle Fourche River and Left Creek, and its invasion of rangeland, where control by 2,4-D is being attempted. The tour proceeded to Devil's Tower Ranch to see green chop and silage making, hybrid sorghum, sudan, artificial insemination, cross-breeding, etc. Owner *Don Steiger* and the three companies mentioned above furnished lunch to complete a fine tour.

LETTER TO THE EDITOR

Dear Mr. Campbell:

The May 1964 issue of the Journal of Range Management is excellent. I congratulate you and all those who have helped make the Journal the magazine it is today. It would seem to me that every member could secure another rancher member by just reviewing that fine article by A. P. Atkins with an appropriate prospect.

Sincerely,
Ray Kent
Spokane, Washington

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SOCIETY BUSINESS

FROM THE PRESIDENT

Membership Brochure

I hope by now you have received, studied and analyzed a copy of the new ASRM membership folder. You will note, I'm sure, some significant changes of interest to all Society members.

Credit for the fine job of revision goes to an ad hoc committee: *Bill Anderson, John Clouston* and *Avon Denham.* It is my purpose in singling-out this particular committee activity only to point out a typical job among many that have become routine in the business of the Socity, and to emphasize that such projects are daily contributing to Society policy and objectives. In my short tenure as a Director and now as President, I have become more and more impressed with the wealth of talent and high-quality ability of the host of Society members serving faithfully on a long list of committees — temporary or standing. In reading the Section newsletters, I find many of these same people very active in the Sections—the nucleus of the Society.

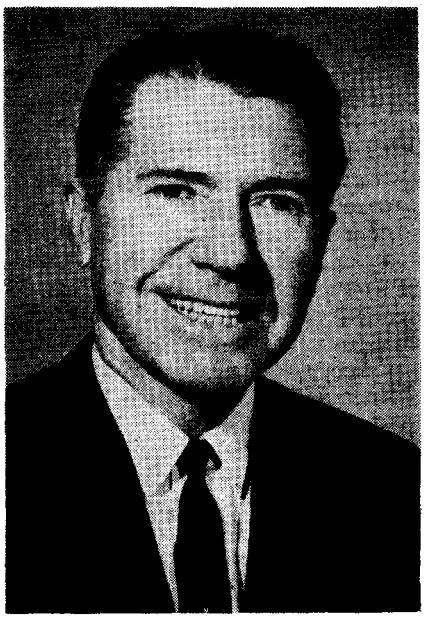
Let's break down the new membership folder in its simplest form—without the attractive photos — so that we can better digest the carefully selected wording. Here goes! And I quote:

JOIN THE AMERICAN SOCIETY OF RANGE MANAGEMENT—The professional Society for all of those interested in the study, management and use of range resources.

Local Field Tours and Discussions on Range and Pasture Management, Improvements, Revegetation, Ranch Operations, Livestock, Game, Watershed, and Research. Sponsors youth training, improved educational and professional standards, co-operative action and judicious resource planning.

MEMBERSHIP—Membership in the American Society of Range Management is open to people who are interested in grazing land management or grazing livestock problems.

Ranchers, teachers, range and pasture specialists, research workers,



wildlife and game technicians, administrators and business executives make and enjoy valuable contacts and associations among the membership of the Society.

Society members get together to discuss facts and new ideas dealing with range and livestock management. In small groups (Sections), they attend Society-sponsored tours, gather at national meetings and, of course, they come together in the pages of the Journal of Range Management. Libraries and institutions may receive the JOURNAL on the same basis as annual memberships.

DUES—You are invited to add your name to our growing list of society members.

Regular members, 1 year	$ 10.00
Student members, 1 year	5.00
Life members	300.00
Foreign (outside North America and U. S. possessions)	10.50

OBJECTIVES—To advance the science and art of grazing land management; promote progress in conservation and sustained use of forage, soil and water resources; stimulate discussion and understanding of range and pasture problems; provide a medium for the exchange of ideas and facts among members and allied scientists; encourage professional improvement of members.

PURPOSE—The American Society of Range Management, publisher of the JOURNAL OF RANGE MANAGEMENT, is an independent, nonprofit, scientific organization for the advancement of intelligent management and use of range and pasture lands and related resources of soil and water.

Its purpose is (1)to assist ranchers, teachers and technicians who work with grasslands to keep abreast of new techniques, new forage plants and other new developments in the grass production and grazing fields and (2) to create an enlightened public appreciation of these resources and the part they play in the social and economic life of the nation.

SECTIONS—Organized Sections and Chapters hold meetings each year. They discuss local range problems. Papers are presented, tours of grazing land are made to study and inspect new methods, procedures, and results of management.

THE SECTIONS ARE: Arizona, California, Colorado, Idaho, Kansas-Oklahoma, Nebraska, Nevada, New Mexico, Northern Great Plains, International Mountain, Pacific Northwest, South Dakota, Southern, Texas, Utah, Wyoming, National Capital, Mexico.

READ THE JOURNAL OF RANGE MANAGEMENT — Read it first in the JOURNAL OF RANGE MANAGEMENT. What's new in range and pasture research, management, improvement? The Journal reports new techniques in grazing, brush control, grass seeding, new methods of grazing land appraisal, new findings of technical workers and rancher experiences. Articles printed in the Journal are easy to read and designed to keep you abreast of current developments in range and grassland management. Journal articles are written by outstanding range and grassland specialists and ranchers from all over the world. (End of quotes)

Don't you agree with me that we

have a great outfit—worthy of our best individual and collective efforts?

Chihuahua Postlude

The word Chihuahua is "music to the ears" for those many of us so fortunate to have been hosted by the Mexico Section July 30-August 1. None will forget the courteous and gracious reception, excellent facilities, noteworthy program and fine entertainment provided by Mexico Section President Martin Gonzales, the Mexico Section membership, the Chihuahua Livestock Union, Rancho Experimental La Campana (national center of livestock research), and associates. In behalf of the entire Society, the Officers and Board of Directors express sincere appreciation and extend very best wishes to the Mexico Section for a bright future. The Section has the potential for very substantially serving needs of the people of Mexico. Just as for each of our eighteen Sections, the only limitation to progress and achievement for the Mexico Section is the sum total of each member's imagination, ingenuity, and willingness to work. The Mexico Section membership demonstrates it has these ingredients.

What does your Board of Directors do at Board meetings, as at the semi-annual meeting in Chihuahua? In spite of the best efforts of the Executive group to handle as much business as possible by correspondence between meetings, the agenda for Board meetings does pile up. At Chihuahua, the Officers met the evening of July 29 to expedite next day's all-day Board meeting.

In brief, the Directors' meeting ran about as given in the following thumbnail sketch, which does not do justice to all the hard work involved.

Report of the President—I stated I believed ASRM progress has been substantial in service, growth and maturity, and that 1964 appears to be a year of consolidation of gains and development of long-range programs. In my opinion, these gains are possible because of the recent efforts of Past Presidents *Anderson* and *Talbot,* Executive Secretary *Clouston,* and many other Society leaders in setting the stage for intensive and streamlined efforts. I expressed sincere appreciation for the cooperation of the Board—the Society's balance wheel for policy and fiscal control—and special thanks to *John Clouston* for keeping me out of serious trouble so far.

Report of the Executive Secretary—We joked with *John Clouston* about his conservative nature, but at Chihuahua he surprised us with expressions of optimism for the future—based on recent achievements in membership gains, improving financial standing, Board and committee activity, and signs of ever-increasing international influence. He reminded us that the Society will before long need a permanent headquarters and a full-time Executive Secretary. We must clear the decks for action by shaping up basic policy on Society operations, including financing from services in addition to dues. The Board authorized a study of one specific financing venture that seems promising.

Reports of Committees and Highlights of Board Action—Liaison with Council of Section Officers — The Board's representative is Past President *Bill Anderson.* He will, among other things, sit with the Council, at its meeting at Las Vegas, February 8, 1965.

Convention City, 1966—January 31-February 4. Place: Jung Hotel, New Orleans, Louisiana. Preliminary Arrangements Committee Chairmen are *George Stephenson* and *Lowell Halls;* Program Committee Chairmen are *Bob Rummel* and *Arnold Heerwagen* — appointed by *President-elect Wasser.*

Convention City, 1967 — Pacific Northwest-Idaho Zone. *Grant Harris* is committee chairman. A bid has been received from Spokane.

Policy on Convention Dates — The Board established the following policy for convention dates of future conventions: "The second full 7-day week of February." This means: 1967—February 14-17; 1968—February 13-16, and so on.

Revision of Handbook for Society Committees—An up-dated Handbook has been prepared through the cooperation of the 1963 committee chairmen, the Executive Secretary, and the President.

Cooperation with Scientific Organizations—Tom Ronningen, General Chairman, reports accelerated activity in cooperation with about twenty scientific organizations, including the National Academy of Science, National Research Council, Scientific Man Power Commision, Society of American Foresters, American Society of Agronomy, Crop Science Society of America, Soil Science Society of America, Soil Conservation Society of America, American Grassland Council, National Watershed Congress, Ecological Society of America, American Society of Animal Science, IX International Grassland Congress, American Institute of Biological Sciences, and others.

Of special interest is the Society's active participation in the planning for the IX International Grasslands Congress to be held in Sao Paulo, Barzil, January 7-21, 1965. President-elect *Wasser,* Editor *Campbell,* and other ASRM members plan to attend.

Code of Ethics — E. J. Dyksterhuis has done a magnificent job of preparing a draft of a Code of Ethics for Society members. The groundwork for this project was previously laid by several Society leaders. Members of the Board have been studying the draft the past several months. I have appointed a committee of officers and Board members to complete a Code of Ethics statement for consideration of the Board at the Las Vegas convention.

Society Exhibit—A portable national exhibit has been prepared and is now in the custody of the Executive Secretary. Slight modifications are to be made in line with revised ASRM policy. The exhibit will be available from the Executive Secretary for national showings, on recommendation of the Public Relations Committee.

History — The History Committee, consisting of Custodian *Alan Beetle* and Historian *Fred Cronemiller,* were complimented for their work in taking good care of ASRM archives and historical material. The Denver Public Library has offered to care for ASRM records in its Conservation Library Center.

Insurance — A thorough study of group insurance for Society members resulted in the Board rejecting the plan submitted by one of the insurance companies. The subject of similar insurance is not closed, however.

International Relations—This committee, under the general chairmanship of *W. R. Chapline,* covers cooperation with a number of organizations in other countries and with

the Peace Corps. The committee has been outstanding in its work with the Food and Agriculture Organization, Agency for International Development, International Agricultural Development, Embassies of Other Nations, IX International Grassland Congress, international relations at ASRM national conventions, distribution of publications and information material to other countries, and with the U. S. State Department.

Inventory of Range Management Research.—This committee, chairmaned by *Ken Parker,* has representation from a wide field of interests. Its fine accomplishments are at the critical stage of securing financial support from outside the Society for the publication of the Inventory of Range Management Research in North America. The Rockefeller Foundation has been contacted and prospects appear favorable.

Journal Improvement Committee.—This ad hoc committee, chairmaned by Director *Don Cox,* has suggested a number of constructive improvements for The Journal. The committee is to report formally at Las Vegas.

Las Vegas Program and Arrangements.—The convention Program Committee, chairmaned by Past President *Danny Freeman,* and the General Arrangements Committee, chairmaned by *Mike Kilpatrick,* are both on schedule and indicate that the Las Vegas convention will reflect the best possible image of the Society in its rapidly growing stature and maturity.

Sub-committees of the Arrangements Committee are also on schedule in their fields of activity, including Photo Contests and Displays chairmaned by *Lenard Smith,* Range Plant Contest chairmaned by *Chuck Saulisberry,* and Interview Service chairmaned by *Paul Tueller.* Several additional sub-committees are hard at work to make Las Vegas memorable in '65!

Membership.—Eamor Nord, chairman, heads a six-member national committee which has taken aggressive steps in a vitalized approach for obtaining new members and holding the old, National membership is expected to top 5,000 in 1964.

Bill Anderson, Avon Denham, John Clouston and I developed a new national membership folder which up-dates ASRM statements of objectives and policy and includes the new membership dues schedule. This new folder is already in wide field use. I recommend each Society member memorize its statements and have a copy at hand.

National Range Resource Review.—*Reg DeNio* chairmans this five-man committee. It has made significant progress to obtain a national range resource review, even though the immediate future does not appear too bright for actuation of either a national public land range appraisal or one of a broader scope covering all range and pasture lands.

Nominations.—Leon Nadeau chairmans this twelve-man all-important committee, which is developing an exemplary slate of Directors and officers for the ballot for the next national ASRM election. The Board concurred in the preliminary slate and complimented the committee for a tough job excellently done.

Policy.—This Society's first president, *Joe Pechanec,* chairmans this five-man committee appointed this year to develop a framework of policy on Society programs and activities. This committee has a very challenging job vital in the Society's future, and is well-advanced in its work. The high-priority tasks which the committee expects to complete this year for consideration of the Board are: a statement on formulation of policy, drafts of the necessary amendements to the Society by-laws, and policy statements for the broader, more significant decisions that have been made up to the present.

Publications.—Past President Bob Campbell, Journal Editor, is general chairman of a large committee consisting of the Editorial Board, Preview of the Las Vegas Convention, Publication of The Journal Material in Spanish, and Range Glossary. Special note is given to the sub-committee, chairmaned by *Gerald Thomas,* for publication of Spanish summaries, and the sub-committee chairmaned by *Don Huss* which has developed a range glossary—an outstanding achievement of great value to both professional and non-professional people interested in range and pasture management. The Board authorized publication of the glossary and its subsequent translation into Spanish.

The recommendation of the Council of Section Presidents at Wichita that Journal technical articles carry a summary in plain language has met with general approval. See separate Editor's report in this issue.

Public Relations.—Don Huss now chairmans this relatively new committee, after the resignation of *John Chohlis* earlier in the year due to his assuming additional responsibilities with the Western Livestock Journal. *Chohlis* will continue to serve as an active member. The committee has a challenging future ahead.

Barry Freeman has developed a Brochure for Rancher Membership, which has been reviewed by *John Chohlis, Bob Campbell,* and the Board. When printed and made available through the office of the Executive Secretary, this special brochure should attract membership of a great many more livestock producers.

Range Education.—President-elect Clint Wasser, general chairman, and *Don Hedrick,* co-chairman, head this large committee covering a wide variety of range management educational effort, including Boy Scout work, the depository library at Utah State University, elementary and high school range management material, 4-H and FFA Projects and Range Camps, Youth Range Facts Forum, scholarships in range management etc. Special note is given to the efforts to set up a national ASRM program of scholarships in range management. A sub-committee headed by *Past-President Don Hervey,* consisting of eight members, is deep in this project and hopes to come up with a plan and finances during 1964.

Range Management Bibliography.—This committee, chairmaned by *Bert Reid,* has prepared an excellent outline for a Range Management Bibliography covering the period from 1935 to date. This will be used as a guide for preparing annual supplements. The committee has aggressively pursued ways and means for the preparation and publication of the main bibliography, with some hope that the National Agricultural Library will do the search work in connection with its preparation of the Bibliography of Agriculture.

Review and Study of Occupational Opportunities and Types of Desired Supplemental Training in Range Management.—Joe Wagner is making this review and study, based on the work of the former Professional

Standards Committee and objectives developed by the Board at the Wichita convention. His report to the Board will result in the appointment of a reconstituted committee of Professional Standards in Range Management.

Special Awards and Citations.—Bob Rummell heads this important committee, which is responsible for nominations to the Board to be considered for the National Medal of Science, Nash Conservation Award, American Motors Award, as well as other special awards or citations in accord with Society objectives and policies. The committee has come up with outstanding nominations.

Other Business.—Among other matters of business acted upon by the Board were such things as ways and means of printing proceedings of national conventions, ASRM employment interview service, ASRM delegate to IX International Grassland Congress, ASRM professional membership in American Grassland Council, the proposal to authorize the organization of a Council of Past Presidents, etc.

I hope the foregoing highlights are indicative to all Society members of the real progress and contributions made by the members of the Board and all committees, involving a large segment of the national membership. The enthusiasm in the committee effort, meetings, tours, conferences—and a legion of letters—add up to a heartwarming feeling for the president. This, however, is of minor consequence, since presidents come and go. The significance is that all this evidence of the mounting drive of the united ASRM would be impressive to anyone. I do not believe there is any one member of our Society that has the president's unique experience of this over-all view of the great work of the Society. I am highly appreciative of this honor the membership has given me. It is a rewarding experience.

AND NOW, ON TO LAS VEGAS IN '65!—*Wayne Kessler*, President.

Highlights

Did you notice the new Journal feature in this issue—a Highlight to introduce each technical article? This addition aims to meet repeated requests from Sections and individuals. The Council of Section Presidents at the 1964 Annual Meeting in Wichita recommended that technical articles carry "summaries in plain language, showing practical application if any." The Board of Directors referred the proposal to the Editorial Board, but this and other questions about the Journal warranted consideration by a broader group. A questionnaire was prepared around the May issue, querying every Journal feature from front cover to Society Business. Some 50 copies were mailed to the Editorial Board, Officers and Board of Directors, Section Presidents, and others representing past editors, past presidents, and national committee chairmen.

Thirty-four members replied, many of them representing local group reactions. Twenty-three favored the summaries. The Highlights, in bold type, will add slightly to the length of articles and to printing costs, but no doubt this can be offset by limiting some other departments.

The dark green color of the cover page is popular; 33 of the 34 replies favored the present color, so your Editor will not tinker with that.

Almost two-thirds of the respondents liked the present format and layout but favored some economies in the Journal if necessary to hold down printing costs. Such measures might include condensing news items both in News and Notes and in With the Sections, fewer photos, and smaller type. Greatest reader interest however, was expressed in News and Notes. Next came Book Reviews, Society Business, Management Notes, the lead technical article, With the Sections, and one technical note, in that order. Comments predominantly favored a variety of technical and applied articles in each issue. As one reply stated, "There seems to be something of value in each issue, not only for me but also for my fellow workers."

There were suggestions that authors and editors could make articles more readable. To quote one: "A *good* technical paper is readable by everyone with a passing knowledge of the subject and a reasonable education . . . including most ranchers and range managers. I would like to see this kept a *good* but *readable* journal." The replies included many helpful suggestions. Your Editor will proceed slowly in making changes. He will appreciate readers' comments and suggestions. —*R. S. C.*

Look for full account of Mexico Section Meeting in November issue.

National Committees

Changes and corrections in national committees of ASRM. Student Employment Service has been renamed ASRM Interview Service Committee. Membership committee includes *George F. Riskie* of Great Falls, Montana. And of course the address of *Don Huss*, Chairman of the Public Relations Committee, is A&M University of Texas, College Station, Texas (not in California as given in May Journal). *Don's* ASRM Range Glossary Committee for 1964 includes: *A. P. Atkins, V. L. Duvall, James K. Lewis, M. W. March, Cy McKell, Alastair McLean, Lysle H. Parson, Larry Riordan, Chuck Saulisberry,* and *Marcial Velasco.*

Membership Committee

RANGE SOCIETY MEMBERSHIP SHOULD HIT 5,000 IN '64 *IF*—Maintaining membership increases at the 10 percent level established last year should produce a total membership of 5,000 during 1965, according to *Dr. Eamor C. Nord,* Membership Chairman. Plans are to identify and give special recognition to the individual as well as his sponsor and the section that enrolls this particular member. Any member except Society officers and membership committeemen is eligible to receive the distinction and acclaim for achieving this goal.

A goal of 5,000 members is realistic considering that total membership reached 4,637 in May, 1964. Gauged on percentage increases and renewals of members last year, "Highest Honors" were earned by Northern Great Plains, New Mexico; Arizona, Idaho and Southern Sections in that order which increased membership at least 10 percent and at the same time had membership renewals of 90 percent or higher. A number of other sections also qualified for honors in various categories.

The 13 percent dropout for non-payment of dues was the lowest the Society has experienced, at least during the last several years. There are indications that membership reinstatements are also running ahead of other years; Pacific Northwest, Texas, Colorado, and Kansas-Oklahoma Sections have shown the best response so far.

Journal subscriptions have likewise accelerated—the increase last year was 12 percent. With the Spanish Summaries of the Journal and with the International Grassland Congress being held in Brazil, the Society is in a most favorable position to advance the cause of range science both at home and abroad.

LAS VEGAS BOUND!

The Nevada Section of the American Society of Range Management invites all members to attend the annual meeting to be held in Las Vegas, Nevada, February 9-12, 1965 at the Dunes Hotel.

The theme of the convention will be "THE RANCHER—THE KEY TO RANGE MANAGEMENT." Topics for the various sessions will include: the ranchers role in range management, a panel on multiple use, a symposium with the Animal Science Society, grazing land problems and practices, soil-vegetation relationships, a panel on pesticides, herbicides, and insecticides and a look towards the future. Look for more details in November issue.