RR-RM

RESEARCH PROGRAM Tucson, Arizona

Study Plan June 1957

STUDY PLAN

Study No. FS-1-r3-1 RM(SR #1)

A Comparison of Vegetation Responses to Grazing

Yearlong, in the Growing Season, and in the

Dormant Season on Low-Value Semidesert Grass-

Shrub Ranges in Southern Arizona

by

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Amended April 3, 1958 by the

"Establishment Report and Supplement to Study No. FS-1-r3-1 RM(SR #1)"

Approved by:

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(Division Chief) (Date) C O N T E N T S

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Yearlong grazing has long been the prevailing practice on south western semidesert ranges. Under such use many semidesert ranges have declined in productivity. Part of the decline in productivity is believed to be caused by yearlong grazing. If year-round grazing year after year is partly responsible for range decline, rest during the growing season should aid in range recovery. In order to determine the effects of winter, summer, and yearlong grazing on the condition and productivity of semidesert ranges, a study is being set up on the Santa Rita Experimental Range.

The results of this study are to be measured mainly on the vegetation. Consequently, the plan for stocking and keeping livestock records will be set up to require a minimum of the researcher's time. Research effort will be concentrated on maintaining adequate vegetation records.

2. Literature Review:

Because of warm winters, yearlong grazing in the Southwest is traditional. However, examples of ranges being maintained in satisfactory condition under yearlong grazing are unusual if not rare. Numerous observations lead to the conclusion that yearlong grazing of semidesert ranges at any practical rate of stocking will ultimately lead to deterioration of the better forage species, at least on easily accessible sites. There are indications that rest at any time benefits the range, but it is suspected that periods of summer growth and spring drought may be most critical. On the Santa Rita such observations have been made on temporary exclosures and on bull pastures where summer deferment has been practiced incidental to the overall range operation.

These undocumented observations agree in part with the findings of many reported studies. Merrill (1954) found that a 4-month rest period in a 16-month grazing cycle improved vegetation. Mueggler (1950) found that heavy grazing during the spring growth period severely reduced forb and grass production in southern Idaho. On the other hand, Rogler (1951) found that neither rotation grazing nor moderate continuous grazing was harmful in North Dakota. Sampson (1951), in a review of pertinent literature on the subject, concluded that regional and local conditions have much to do with the results of rotation grazing; that rest during the growing season was especially beneficial to bunchgrasses but that sod grass ranges do not appear to be harmed by moderate season-long or continuous grazing. Frandsen (1950) concluded that it is very difficult to prevent range forage deterioration on season-long ranges, especially near water. So, even in the absence of adequate research results from the Southwest, there seems to be enough evidence against continuous season-long or yearlong grazing to justify testing some other plan of grazing on the traditionally yearlong semidesert grassland ranges.

3. Objectives:

a. To determine whether growing-season, dormant-season, or yearlong grazing is best for maintaining or improving the density, species composition, and herbage yield of important perennial forage grasses on low-value mesquite-infested ranges.

b. To determine the effects of season of use on utilization and on density, species composition and production of perennial grasses at points 1/4-mile, 5/8-mile, and 1-mile from stock water.

c. To determine the responses of perennial grasses to mesquite control under different seasons of use at different distances from water and on different soil types.

d. To evaluate interactions between season of use, soil type, distance from water, and mesquite control with respect to their effects on perennial grasses.

e. To determine whether cattle do better on semidesert ranges if shifted from one pasture to another twice yearly or if yearlong grazing is more desirable.

4. Methods:

a. General plan for study.--The general plan for the study involves setting up three seasons of grazing use. These are: growing season (approximately 6/1 to 11/15), dormant season (11/16 to 5/31), and yearlong. Once established, these three seasons of use, each applied to two pastures will provide an opportunity to study the interactions between season of use and other treatments or factors that may be superimposed on or that may occur within the area subjected to each grazing treatment. Mesquite control, reseeding, erosion control structures, and other similar treatments may well be applied to selected sample areas within the pastures set up in the grazing program. Stocking for each pasture will be based on the average for the 10-year period 1946-55. Cattle numbers will be adjusted each year by mutual agreement with the cooperator. The utilization objective for perennial grasses will be 40 percent. Beginning and ending dates for the growing season and dormant season grazing periods are flexible rather than rigid and are intended to coincide with dates of normal spring and fall roundups. Special roundups will not be necessary, ordinarily. However, in no case are cattle to be permitted in the dormant-season pastures during the growing season or in the growing-season pastures during the dormant season. Also, during the 10-year course of the study, numbers appreciably in excess of the average for the 1945-55 period will not be permitted.

b. Variables under test.--The variables under test include:

(1) Three seasons of grazing, namely, yearlong, growing season (approx. June 1-Nov. 15), and dormant season (approx. Nov. 16-May 31).

(a) Three distances from water (1/4, 5/8, and 1 mile).

(b) Two degrees of mesquite invasion (current stand and cleared).

(c) Two general soil types classified here as (1) "open", including Comora coarse sandy loam, Tumacacori coarse sandy loam, and Sonoita sandy loam, and (2) "tight" including Whitehouse coarse loam, Continental gravelly loam, Continental sandy loam, and Tubac sandy loam. (In general, the so-called "open" soils are relatively rock free, gray in color, without a well developed profile or hardpan and with relatively low clay content. On the other hand, the "tight" soils are generally rocky, reddish in color, with well developed hardpan and relatively high clay content.

c. Data to be taken.--The effects of season of grazing, distance from water, degree of mesquite invasion, and soil type will be measured or recorded by means of the following types of data obtained from 12 pairs of plots in each pasture:

(1) Density and species composition of perennial grass stand as measured on permanent line transects.

(2) Utilization of perennial grasses as measured by the tuft count method.

(3) Yield of perennial grasses as obtained by double sampling on permanent plots. Forage estimates will be adjusted for utilization where necessary.

(4) Visual change in range condition as recorded by photographs from permanent photo stations.

(5) Actual stocking.

(6) Calf crops.

(7) Calf weights "at shipping time."

(8) Physical condition of cows and calves "at spring and fall roundups," as recorded by individual and group photographs.

(9) Death losses.

d. Analysis of data.--The analysis of data listed in section "c" will consist of several variance analyses of varying complexity. The most simple analysis will be that which applies to pasture means, changes in time within the pasture (expressed as differences) or pasture totals for a single year. Such an analysis can be made for any one year for all items in which a numerical scale of measurement is employed. This analysis which will test overall effects of the grazing treatment involves a total of only 5 degrees of freedom with only 2 degrees of freedom in the error term. Another weakness which should be recognized now is that the 6 pastures are not strictly comparable. Also, the cattle in pastures 5N, 5S, and 6B, which belong to Ruelas, differ in quality from Brown's cattle in pastures 3, 2N, and 12B. Because of these natural differences, it is expected that pasture means for a given year may contain so much natural pasture-to-pasture variation that the treatment imposed differences cannot be determined with certainty. However, it may be possible after a few years to use this very simple analysis to test differences among pastures in amount or direction of change. The outline for this very simple analysis is:

Source of Variance DF

Grazing season 2

Block 1

Discrepancy 2

The shortcomings of this analysis are illustrated by inserting the following assumed figures in a test analysis as follows:

Grazing Season Block

Ruelas Brown

Summer 10 15

Yearlong 20 30

Winter 30 45

This very consistent arrangement of values gives the following analysis:

SS DF MS F

Grazing season 625 2 312.5 25.0x

Blocks 150 1 150.0

Discrepancy 25 2 12.5

x Significant at 5 percent level

The F value of 25.0 for season exceeds the minimum 5 percent value of 19.00 by an uncomfortably small margin, especially since such a small mean square for discrepancy is unlikely to occur in practice. It seems unlikely that this test will reveal any significant differences among pasture means or totals for a given year. However, repetition in time may provide significant differences.

More elaborate tests will be used to test vegetation changes. These tests will involve two replications within each pasture, two soil types, and three distances from water, and the random assignment of mesquite control to one of two plots at each location. The outline for the analysis of one year's data, or one set of differences between two sets of data, is:

Source of Variation DF

Blocks (cooperators) 1

Grazing seasons 2

Soil types 1

Distance from water 2

G x S 2

G x D 4

S x D 2

G x S x D 4

Sites within treatments 36

Error (a) 17

Sub-total 71

Mesquite treatments 1

Mesquite treatments x

other treatments 18

Error (b) 53

Sub-total 72

\_\_\_\_\_\_\_\_\_

TOTAL 143

e. Sensitivity of test.--It is expected that the analysis of data on perennial grasses will provide significant statistical evidence of the effects of treatment. It is questionable whether the data for a single year on calf crops, livestock condition, etc., will prove significant by the more simple test that is applicable to them. However, if consistent differences occur over a period of several years, replication in time may provide significant data.

5. Presentation of Expected Results:

a. Audience and organ.--This study should provide information that will be useful to cattle ranchers on semidesert range throughout the Southwest. When completed, the study should justify publication as a USDA Circular or Farmers' bulletin. Intermediate results will be released as station notes or through appropriate livestock journals.

b. Form in which data will be presented.

(1) Tables and charts - detailed data involving several criteria of classification will be presented in suitable tabular form if such presentation seems justified. But, the number of possibilities for arranging data are so great that many forms of presentation may be possible.

(2) Photographs - Ample photo stations will be established to insure having before-and-after pictures to illustrate changes that occur in the vegetation. Pictures of cattle will also be taken to show changes or differences in livestock condition. The best of these photographs will be used to illustrate the final manuscript.

6. Responsibility and Cost:

a. Assignment.--Cable, Martin, and field assistants.

b. Estimated cost for 10-year period.

(1) Man power

(a) Field assistants (6 wks/year) $4,000

(b) Technical (field) (3 wks/year) 4,350

(c) Technical (office) (6 wks/year) 8,700

(d) Clerk (4 wks/year) 2,600

(2) Materials

Fencing 7 « miles, cattle guards, etc. 6,000

Photography supplies 300

Automotive expense 1,000

Mesquite control 50

Plot stakes 40

Witness posts 100

27,140

c. Time of completion.--The study should run 10 years. If it is started in 1957, it should be completed in 1967.

7. Appendix:

a. Location and description of study area.--The study will be conducted on the Santa Rita Experimental Range using pastures 2N, 3, 5N, 5S, 6B, and 12B. The arrangement of these pastures is shown in Figure 1. (Figure 1. is titled Map of SRER showing area involved in grazing treatments. It is not included in the digital file).

b. Selecting and marking plots.--Within each pasture, 12 pairs of plots will be located so that 4 are 1/4-mile from water, 4 are 5/8-mile from water, and 4 are 1-mile from water. Two of the plots at each distance will be located on open soils and two will be on tight soils. Table 1 is a list of plot numbers and descriptions (approximate plot locations are shown in Figure 4) (Figure 4 is not included in digital file, see original). At each plot location two permanent 100-foot line transects will be established so that they are at least 150 feet apart at the closest point.

By random choice, one transect will be left undisturbed. All mesquite within 50 feet of the other transect will be killed. Thus, each transect lies in the center of an imaginary plot 100 feet wide by 200 feet long.

Table 1.--Assigned numbers and descriptive data for sampling sites.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Distance Broad Soil Nearest

Pasture Site to Soil Class Livestock Bearing

No. No. Water Type 1/ Water

5N 1 1/4 Open 1 N. Rim NW

2 5/8 " 1 " NNW

3 1 " 1 N. Tank NW

4 1/4 Tight 8 " SE

5 5/8 " 5 NW Rim NE

6 1 " 7 Desert Tank NW

7 1/4 Open 1 NW Rim NW

8 5/8 " 8 NW Rim NW

9 1 " 1 Desert Tank NE

10 1/4 Tight 7 " NW

11 5/8 " 7 " NW

12 1 " 7 " NW

5S 1 1/4 Open 2 N. Rim W

2 5/8 " 2 " SW

3 1 " 2 Kinney Tank E

4 1/4 Tight 5 " SW

5 5/8 " 5 Kinney Tank NW

6 1 " 7 " W

7 1/4 Open 2 NW Rim S

8 5/8 " 2 Kinney Tank NE

9 1 " 2 NW Rim S

10 1/4 Tight 5 Kinney Tank S

11 5/8 " 8 N. Rim S

12 1 " 8 N. Rim SW

Table 1 - Cont'd

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Distance Broad Soil Nearest

Pasture Site to Soil Class Livestock Bearing

No. No. Water Type 1/ Water

3 1 1/4 Open 3 Hughes Tank SE

2 5/8 " 3 " SE

3 1 " 3 " SE

4 1/4 Tight 4 " W

5 5/8 " 4 " NW

6 1 " 4 " SE

7 1/4 Open 1 Desert Corral NW

8 5/8 " 1 " NW

9 1 " 1 " NW

10 1/4 Tight 4 Hughes Tank N

11 5/8 " 4 " NE

12 1 " 4 Desert Corral N

12B 1 1/4 Open 3 Amado Well E

2 5/8 " 3 West Tank SE

3 1 " 3 Amado Well E

4 1/4 Tight 4 West Rim S

5 5/8 " 4 " S

6 1 " 4 " SE

7 1/4 Open 3 West Rim NE

8 5/8 " 3 " SE

9 1 " 3 " SE

10 1/4 Tight 4 Horseshoe T. W

11 5/8 " 4 " W

12 1 " 4 " W

2N 1 1/4 Open 1 Middle Tank NW

2 5/8 " 1 " NW

3 1 " 1 " NW

4 1/4 Tight 8 " NE

5 5/8 " 8 " SE

6 1 " 8 " NE

7 1/4 Open 1 Desert Corral NE

8 5/8 " 3 " NE

9 1 " 2 " NE

10 1/4 Tight 8 Box Rim NW

11 5/8 " 8 " NW

12 1 " 8 Desert Corral NE

Table 1 - Cont'd

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Distance Broad Soil Nearest

Pasture Site to Soil Class Livestock Bearing

No. No. Water Type 1/ Water

6B 1 1/4 Open 1 Desert Sta. NW

2 5/8 " 1 " NE

3 1 " 2 " SE

4 1/4 Tight 8 " NE

5 5/8 " 8 " SE

6 1 " 8 " SE

7 1/4 Open 2 Northeast Rim S

8 5/8 " 2 " S

9 1 " 2 " S

10 1/4 Tight 8 Cholla Tank NW

11 5/8 " 8 " NW

12 1 " 8 " NW

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1/Soil Classification Code

A. Open, relatively rock-free, greyish soils.

1. Comora Coarse Sandy Loam.

2. Tumacacori Coarse Sandy Loam.

3. Sonoita Sandy Loam.

B. Tight or Rocky, Reddish Soils.

4. Continental Sandy Loam, gravelly.

5. Continental Loam.

6. Continental Gravelly Loam, stony phase.

7. Tubac Sandy Loam.

8. Whitehouse Coarse Sandy Loam.

Transects will be marked at each end and at the 50-foot mark by iron stakes not less than 1/2-inch in diameter and at least 4 inches high. A steel fence post will be set in line between the "0" ends of the transects (see sketch on page 14 of digital file).

c. Treatments

(1) Grazing treatments--approximate numbers of cattle run in each pasture during the past 10 years, and planned seasons of use for each pasture are:

2N - 60 head yearlong

3 - 70 head 11/16 to 5/31

12B - 70 head 6/1 to 11/15

6B - 90 head yearlong

5N - 100 head 11/16 to 5/30

5S - 100 head 6/1 to 11/15

Stocking on these pastures will be on a flexible basis. Cooperators may remove cattle during drought or reduce numbers whenever they find that the condition of the cattle warrants such action. Otherwise, cattle numbers will be adjusted each fall to utilize 40 percent of the current year's growth of perennial grass. In no case shall the winter or summer pastures be grazed except during the prescribed season. The number of cattle on each pasture will be determined by:

(a) Determining the total amount of perennial grass herbage by forage survey.

(b) Multiplying total herbage by 0.4 to determine usable herbage.

(c) Determining the average amount of grass used per animal per day from past records of forage production, actual stocking, and utilization.

(d) Dividing total herbage in pasture by the product obtained by multiplying the average amount of feed used per day by the number of days remaining in the grazing year.

SKETCH OF PLOT LAYOUT DESIGN

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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| X | O | X |

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| X | | X |

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|\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_| |\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_|

/|

|

|

NORTH

0 50 100 150 200 250

|\_\_\_\_\_|\_\_\_\_\_|\_\_\_\_\_|\_\_\_\_\_|\_\_\_\_\_|\_\_\_\_\_|\_\_\_\_\_|\_\_\_\_\_|\_\_\_\_\_|\_\_\_\_\_|

Scale in feet

O is 5 ft. Steel fence post used as witness post

X are transect stakes marking the 0, 50 and 100 foot locations

\_\_\_\_\_ are the plots boundaries

This system provides best for adjusting numbers on the winter-used pastures but for lack of a better method it must also be used on the yearlong and summer-grazed pastures.

(2) Mesquite treatments--At each transect where mesquite control is specified, all mesquite within 50 feet of the transect will be killed with diesel oil.

d. Instructions for Taking Data

(1) Photographs--The photographic record of vegetation changes will consist of one photo taken from the south end of each transect or from a designated "footmark" along the line. All photo stations will be photographed at the beginning of the study and at the end. In intervening years, only selected photo stations will be rephotographed each year. Plots to be rephotographed annually will be selected after the first complete set of pictures is taken and will include a cross section of conditions and treatments.

The photographic record of cattle condition will be made up of pictures taken at each roundup. The following types of pictures are suggested:

(a) A group of cows taken looking down on cattle from horseback or corral fence to show general condition of group.

(b) A group of calves.

(c) One or more of the wet cows that are in the best condition.

(d) One or more of the wet cows in the poorest condition.

(e) Typical cow and calf.

All pictures will be taken on 4x5 black and white film. Prints and negatives will be appropriately labeled and filed with other data on the study.

(2) Line transects--Line transect data will be recorded on the Regular Santa Rita line transect record form (not included in digital archive, refer to original). For each grass tuft or shrub intercepted, length of intercept will be recorded.

In laying out permanent line transects the tape is placed against the right hand side of the stakes as the observer stands at the "0" end and looks toward the other end of the line. The "0" mark of the tape is placed at the "0" stake. The tape is then stretched as close as possible to the ground in a straight line from the "0" stake to the 100 M. stake. A stake will also be set at the 50-foot mark to aid in reestablishing the line.

After the tape is pulled straight and fastened at both ends, the vertical intercept of perennial vegetation along the lefthand or inside edge of the tape is measured and recorded. In the following instructions the letter in parenthesis refers to a longhand letter on the attached sample "Line Transect Record". Each item letter is followed in order by the item name as it appears on the form, then by underscored words indicating the kind of data to be entered and finally by an explanation of what is to be recorded and how.

Data to be Recorded on the "Line Transect Record"

(Identification Data)

(a) Study-title.--Enter brief title of study or project.

(b) Pasture-number.--Enter number of pasture in which transect is located.

Plot number.--Enter number of plot on which transect occurs. Each plot number will consist of the site no. (as in Table 1), followed by the letter "A" or "B". "A" will designate plots to be cleared of mesquite and "B" will designate uncleared plots.

(d) Transect-number.--Same as plot number.

(e) Date-day-month-year.--Enter date of observation listing day first, month second, and year third.

(f) By-initials.--Enter initials of observers. Record initials of observer first, recorder second.

(Data on Perennial Grasses)

[NOTE: (g) WAS DELETED ON ORIGINAL]

(h) Intercept (.01 ft.)-lengths of intercepts.--Enter length of each intercept in units of .01 ft. Each species is to be recorded separately opposite the proper symbol. Separate individual measurements by dashes. The intercept of perennial grasses is measured at the ground line.

Only the live-rooted portion of the tuft is measured. The smallest unit of measurement is .01 ft.,recorded as "1".

(I) Intercept (.01 ft.)-total by species.--Record total intercept for each species.

(j) Grass species-symbol.--Enter species symbol for any perennial grass that intercepts the line

and whose symbol is not listed on the form.

(k) Intercept (.01 ft.)-total all spp.--Compute and record total intercept of all perennial grasses.

(Data on Shrubs)

[NOTE: (l) WAS DELETED ON ORIGINAL]

(m) Intercept (.01 ft.)-lengths of intercepts.--Record length (in units of .01 ft.) of live crown intercept. Measure entire live crown intercept but do not include conspicuous openings or areas of dead crown.

(n) Intercept (.01 ft.)-totals by spp.--Enter total intercept for each shrub species.

(o) Shrubs-symbol.--Record symbols for species that are intercepted but not listed.

(p) Intercept (.01 ft.)-total all spp.--Enter total intercept for all shrub species.

Line transect data will be taken annually from 1957 to 1959 and from 1965 to 1967, August or early September.

[COPY OF SRER LINE TRANSECT RECORD NOT IN DIGITAL FILE, SEE ORIGINAL]

(3) Utilization estimates--Utilization checks using the tuft count method will be made annually on the 100' x 200' plot surrounding each transect. (To provide a tie in with past records, the current method of estimating utilization will be continued for at least two years in order to correlate results obtained by the two systems. The "current" method is outlined in "Instructions for Utilization Survey on Santa Rita Experimental Range".) Approximate dates for taking utilization data in each pasture are:

2N and 6B - June 30 (yearlong)

5S and 12B - Nov. 16 (summer)

3 and 5N - June 1 (winter)

The paced transect method of sampling will be used to select tufts on which utilization is to be observed. At the end of each full pace, the perennial grass tuft nearest the left (or right) toe will be observed for utilization. If no grass tuft occurs within about two feet of the toe another pace will be taken, etc., until 100 tufts (or 50 tufts on very sparse plots) have been observed. The paced transects will be run parallel to the line transect at intervals of 15 to 20 feet. Since the vegetation is very sparse on some parts of the study area, several parallel courses across the plot will be necessary in order to encounter 100 suitable perennial grass tufts. Grass tufts that are beneath shrubs or entangled in them will not be used in determining utilization because they are not readily available for grazing.

The 100 tufts in the utilization sample will be recorded on the "Utilization Record" by species and class of grazing use. In the following instructions for using the "Utilization Record" the letters in parenthesis refer to pen and ink letters on the attached sample form (17a, not included in digital archive, see original). Item letters are followed in turn by the item name as it appears on the form, then by underscored words indicating the kind of data to be entered, and finally by an explanation of how the data is to be obtained.

[COPY OF SRER UTILIZATION RECORD NOT IN DIGITAL COPY, SEE ORIGINAL]

Data to be Recorded on the "Utilization Record"

(Identification Data)

(a) Study-title.--Enter brief title of study.

(b) Pasture-number.--Enter number of pasture in which data is taken.

Transect-number.--Enter number of plot.

(d) Date-day-month-year.--Enter data is taken in the order day-month-year.

(e) By-initials.--Enter initials of observer.

(Data on Utilization)

(f) Plants grazed-tally.--Record by tally opposite the proper species symbol each grass tuft that is grazed. Specific names for the symbols listed are typed in on the sample form.

(g) Plants grazed-total by spp.--After transect is completed enter total numbers of grazed plants by species.

(h) Plants ungrazed-tally.--Record by tally opposite the proper species symbol each perennial

grass tuft that is in the open but is ungrazed.

(I) Plants ungrazed-total by spp.--After transect is completed, enter total number of ungrazed

plants of each species.

(j) Spp.-symbol.--If necessary add symbols for species not listed on form.

(k) Plants grazed-total all spp.--Determine and record total number of grazed plants.

(l) Plants ungrazed-total all spp.--Determine and record total number of ungrazed plants.

(4) Herbage production.--Herbage production estimates will be made annually at each transect location. The herbage estimate at each transect location will consist of estimates on two 8' x 24' permanent plots with their long axis lying along the transect. At each transect the

plot that extends from 0-24' along the transect will be number 1, the one from 50'-74' number 2, etc. All herbage estimates will be made as soon as possible after the close of the summer growing season. Where utilization has occurred the herbage estimate will be adjusted accordingly.

In the following instructions for use of the "Herbage Production Record" the letters in parenthesis refer to longhand letters entered on the attached sample form (page 22a, not included in digital copy, see original). Item letters are followed in turn by the item name as it appears on the sample form, then by underscored words indicating the kind of data to be entered and finally by a explanation of how the data is to be obtained.

Data to be Recorded on the "Herbage Production Record"

(a) Study-title.--Enter brief title of study.

(b) Pasture-number.--Enter number of pasture in which observation is made.

Line-number.--Enter "line" or transect number.

(d) Date-day-month-year.--Enter date of observation.

(e) By-initials.--Enter initials of observer.

(Data on Yields of Perennial Grasses)

(f) Estimated field weights-grams.-Enter estimated weight to nearest gram of each perennial grass species on each plot and record in appropriate cell. Species that are grazed will require two entries, i.e. the amounts of herbage observed and, in parenthesis, an ocular estimate of the percent use. Portions of grass tufts that are protected from grazing by shrubs or cactus are not to be included in the herbage estimate. All herbage estimates for the first plot are to be recorded in column #1, for the second in column #2, etc. Species names for the symbols printed on the form are typed in on the sample.

(g) Total by species-grass.--Total individual herbage estimates for each species and enter totals in "TOTAL" column.

(h) Clipped plot-number.--Enter number of plot that is clipped.

(I) Actual weights (perennial grasses)-grams.--Record weights of herbage clipped (to nearest gram) by species.

Perennial grasses will be clipped as close as possible to the ground line. Insofar as is practical, only the current season's growth will be collected. Most of the older dead material will be removed by (1) combing dead stems and leaves out of the tuft before clipping, and (2) shaking out short dead stubble by striking the base of the clipped herbage a few times with the shears.

Clippings of herbage from individual plots will be kept and accumulated until about 100 grams of herbage (field weight) of each class is available. These samples will be air-dried and re-weighed to determine the dry weight factor for each herbage class.

(j) Species-symbol.--Enter symbols for species that occur on the plots but which are not listed on the form.

(k) Total-grass.--Compute and enter totals for all columns.

(l) Avg. Green Wt.-grams.--Compute and record (in grams and tenths) the average yield (estimated field weight) of perennial grass per plot.

(m) Avg. Dry Wt. (perennial grass)-percent.--After the dry weight factor (item u) has been determined, multiply the average green weight (item l) by the dry weight factor to obtain the average dry weight of perennial grasses per plot.

(Data on Annual Grasses)

(n) Estimated field weights (annual grasses)-grams.--Enter estimated weights of annual grasses by plots. (In high production years it will be impractical to estimate or clip annuals on the entire 8' x 24' plot. In such cases, only a portion of the plot will be used. The portion actually used must be recorded on the form.)

(o) Total estimated annual grasses-grams.--Add individual plot estimates together and enter total amount for annual grasses.

(p) Actual weights annual grasses-grams.--Enter field weight of annual grass herbage clipped from plot. Annual grasses are to be clipped as close to the ground as possible taking reasonable care to include only current year's growth (see items h and I).

(q) Average dry wt. (annual grasses)-number.--Multiply total annual grasses (item o) by the appropriate dry weight factor for annual grasses (item u). Divide answer by number of plots to obtain the plot average and record.

(r) Species-PG, AG, or Symbol.--Head columns for moisture data by PG (perennial grass), AG (annual grass), or the proper symbol if for a single species.

(s) Field Wt.-Grams.--Record field weight under appropriate heading. If herbage sample is the accumulation from several clipped plots enter the total of the individual plot field weights. Do not accumulate material from several plots then weigh the total.

(t) Dry wt.-grams.--Enter air-dry weight of herbage sample. Samples left to air-dry in the laboratory at the Santa Rita usually reach equilibrium within one or two weeks. Samples must be allowed to reach equilibrium before air-dry weights are recorded.

(u) Pct. dry-percent.--Divide dry weight (item t) by field weight (item s), convert to percentage, and record as a whole number.

(v) Total dry herbage-grams.--Add items m and q.

Adjustment for utilization: Columns 1 and 2 of the form on page 22a (not included in digital file, see original) will be used to record the estimated amount of herbage (grams) on the ground at the time of the observation for plots 1 and 2, respectively. Total herbage on the ground for the two plots will be recorded in column 3. The estimated amount of herbage used (grams) on plot 1 will be recorded in column 5 and the amount of herbage removed from plot 2 in column 6 with column 7 used for the two-plot total.

[COPY OF SRER HERBAGE PRODUCTION RECORD NOT IN DIGITAL FILE, SEE

ORIGINAL]

e. Schedule of field work

1956

(1) Construct fences, cattle guards, watering rims, etc.

(2) Continue present grazing practices.

1957

(3) Take utilization as in past (June).

(4) Install permanent line transects (June-Aug.).

(5) Take initial photos (June-Aug.).

(6) Take herbage production data (Sept.-Oct.).

(7) Begin new grazing program (Nov.).

Yearly 1958-1967

May 31 - move cattle from 3 to 12B and from 5N to 5S.

June 1 - check utilization in 3 and 5N.

June 30 - Check utilization in 2N and 6B.

Sept. 15 - Oct. 15 - forage estimate, all pastures, and take scheduled pictures.

Nov. 15 - move cattle from 12B to 3 and from 5S to 5N.

Nov. 16 - check utilization in pastures 5S and 12B.

Yearly 1957-1959 and 1965-1967, only

Aug. - remeasure line transects, all pastures.

(8) Kill mesquite on designated plots (Nov.-Dec.).

f. References

(1) Frandsen, Waldo R. 1950. Management of reseeded ranges. Jour. Range Mangt. 3(2): 125-129.

(2) Martin, S. Clark. 1956. An analysis of problems on semi-desert ranges and program of grazing management research for the Santa Rita Experimental Range. In files, Rocky Mtn. For. & Range Exp. Sta.

(3) Merrill, Leo B. 1954. A variation of deferred rotation grazing for use under southwest range conditions. Jour. Range Mangt. 7(4): 152-154.

(4) Mueggler, Walter F. 1950. Effects of spring and fall grazing by sheep on vegetation of the Upper Snake River Plains. Jour. Range Mangt. 3(4): 308-315.

(5) Parker, Kenneth W. 1948. An analysis of range problems in the southwest. In files, Rocky Mountain Forest & Range Exp. Sta.

(6) Pearse, C. Kenneth. 1953. Problem analysis and working plan for grazing management research, Santa Rita Experimental Range. In files, Rocky Mountain Forest & Range Exp. Sta.

(7) Rogler, George A. 1951. A twenty-five year comparison of continuous and rotation grazing in the northern great plains. Jour. Range Mangt. 4(1): 35-41.

(8) Sampson, Arthur W. 1951. A symposium on rotation grazing in North America. Jour. Range Mangt. 4(1): 19-24.

FS-1-11-1-RM (SR #1)

Estimated manpower requirement (man days)

Job 1957 1958 1959 1960 1961 1962 1963 1964 1965 1966

Measuring transects30 30 30 30 30 30

Forage Survey 6 6 6 6 6 6 6 6 6 6

Utilization 6 6 6 6 6 6 6 6 6 6

L.S. Records 6 6 6 6 6 6 6 6 6 6

Photos (Veg.) 6 2 2 2 2 2 2 2 6 6

(L.S.) 2 2 2 2 2 2 2 2 2 2

Precipitation 1 1 1 1 1 1 1 1 1 1

Supplemental Feed 1 1 1 1 1 1 1 1 1 1

Cooperation 6 6 6 6 6 6 6 6 6 6

Totals 64 60 60 30 30 30 30 60 60 66

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RR-RM

RESEARCH PROGRAM Tucson, Arizona

Study Plan April 3, 1958

Establishment Report and Supplement to Study Plan

Study No. FS-1-r3-1-RM(SR #1)

A Comparison of Vegetation Responses to Grazing Yearlong, in the Growing Season, and in the Dormant Season on Low-Value Semidesert Grass-Shrub Ranges in Southern Arizona.

Reference is made to the schedule of field work, page 23 of the study plan. All field jobs scheduled for 1956 and 1957 were completed as scheduled. About 65 man days field time were spent on the study. In a few instances the field jobs were not carried out exactly as called for in the study plan. These changes in procedures are listed below.

1. Page 5 item (7) --Delete "where available". Insert, "at shipping time".

2. Page 5 item (8)--Delete "June 1 and November 15". Insert "at spring and fall roundups".

3. Page 9 (bottom of page)--Delete "as indicated below" and cross out drawing at bottom page.

4. Page 12.--revise first paragraph to read: "Transects will be marked at each end and at the 50 foot mark by iron stakes not less than « inch in diameter and at least 4 inches high. A steel fence post will be set in line between the "0" ends of the transects (see sketch page 14).

5. Page 12a.--Insert new page to be numbered 12a showing plot layout.

6. Page 13.(2) Mesquite treatments. Delete: "Seedling trees will be grubbed. Larger trees will be".

7. Paragraph d(1) line 2: change "0" to "south".

8. Page 13, paragraph d(1), third sentence, change "1/4" to "1/3".

9. Page 13--Revise last sentence of paragraph "d.(1)" to read: "Thus, plots 1, 2, 4 and 5 in each pasture will be rephotographed every year".

10. Page 14--paragraph (2) second sentence, delete: "both the distance from "0" and"

11. Page 14--second paragraph under (2). Delete last sentence and change the two preceding lines to read: "the 100-ft. stake. A stake will also be set at the 50 foot mark to aid in reestablishing the line.

12. Page 15.--Delete all of paragraph (g).

13. Page 16, line one, add: "recorded as "1"."

14. Page 16,--Delete all of paragraph (1) and revise last sentence to read: "Line transect data will be taken annually from 1957 to 1959, and from 1965 to 1967, preferably in late August or early September."

15. Page 16a, change "Opun" to "OPUN".

16. Page 17, second paragraph, 5th line--Insert "(or 50 tufts on very sparse plots)" after the figure "100".

17. Page 19. Revise first paragraph to read.-- "(4) Herbage production.--Herbage production estimates will be made annually at each transect location. The herbage estimate at each transect location will consist of estimates on two 8' x 24' permanent plots with their long axis lying along the transect. At each transect the plot that extends from 0 to 24' along the transect will be number 1, and the one from 50' to 74' will be number 2. All herbage estimates will be made as soon as possible after the close of the summer growing season. Where utilization has occurred, the herbage estimate will be adjusted accordingly.

19. Page 22, bottom of page, add: Adjustment for utilization: Columns 1 and 2 of the form on page 22a will be used to record the estimated amount of herbage (grams) on the ground at the time of the observation for plots 1 and 2, respectively. Total herbage on the ground for the two plots will be recorded in column 3. The estimated amount of herbage used (grams) on plot 1 will be recorded in column 5 and the amount of herbage removed from plot 2 in column 6 with column 7 used for the two-plot total.

20. Page 23. Insert as item (8): Kill mesquite on designated plots (Nov.-Dec.).