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DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

RANGE SURVEY GUIDE

Revised Edition Prepared by

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INTRODUCTION

This Range Survey Guide outlines methods for making condition and utilization measurements on key browse or grass species within key range areas. Condition measurements from different years are compared to reflect trends.

The described methods are particularly suited to management operations where range data must be obtained over large areas with few personnel. In using the methods, desired plant conditions and levels of utilization are first set as management goals. For wildlife management operations, yearly plant condition and utilization measurements are related to set goals and yearly kill or removal figures. Subsequent kills or removals are adjusted as needed to achieve desired plant condition trends and utilization levels. For livestock management operations, or situations where wildlife populations can be censused, condition and utilization measurements are related directly to animal numbers to assess whether a range is properly stocked in relation to desired plant condition trends and utilization levels.

A key browse or grass species should be one of the more important forage plants on a range area. It should represent a forage source which cannot be overused without causing a significant reduction in animal carrying capacity or causing conflict with other management objectives. Other management objectives may relate to preventing animal depredations on private property, maintaining satisfactory watershed conditions, allocating forage on dual-use ranges or maintaining a particular biotic community.

A key range area should be a significant unit of rangeland. It should be necessary that the plants on a key range area be maintained in or restored to a satisfactory condition in order to fulfill such objectives as maximizing animal carrying capacity, protecting a watershed or maintaining a particular biotic community. Sample units for measuring key plant species condition and utilization should be located on representative sites within key range areas.

BROWSE CONDITION AND UTILIZATION SURVEYS

1. Equipment needed.

   Clipboard and forms
   Two steel stakes for each sample unit

2. Period and frequency of surveys.

   Surveys are conducted each spring before new leaf or leader growth becomes pronounced. Partial surveys involving utilization checks alone may be conducted at other times to measure use during other seasons or separate summer and fall livestock use from winter game use.

3. Establishment of a sample unit.

   Steel stakes are driven about three and six feet from the base of a selected browse plant. An imaginary line, extending through the stakes and the selected browse plant serves to establish the course followed in sampling (Figure 1). An identifying marker is wired to the stake farthest from the selected browse plant.

4. Measurements.

   Form and age class assignments 1/ and leader use estimates are considered measurements. They are as follows:

Form Classes	Age Classes
1 All available, little or no hedging	S - Seedling
2 All available, moderately hedged	Y - Young
3 All available, severely hedged	M - Mature
4 Partially available, little or no hedging	D - Decadent
5 Partially available, moderately hedged	
6 Partially available, severely hedged	
7 Unavailable	
8 Dead	

1/ Modified slightly from Dasman W. P., 1951. Some deer range survey methods. California Fish and Game 37(1):43-52

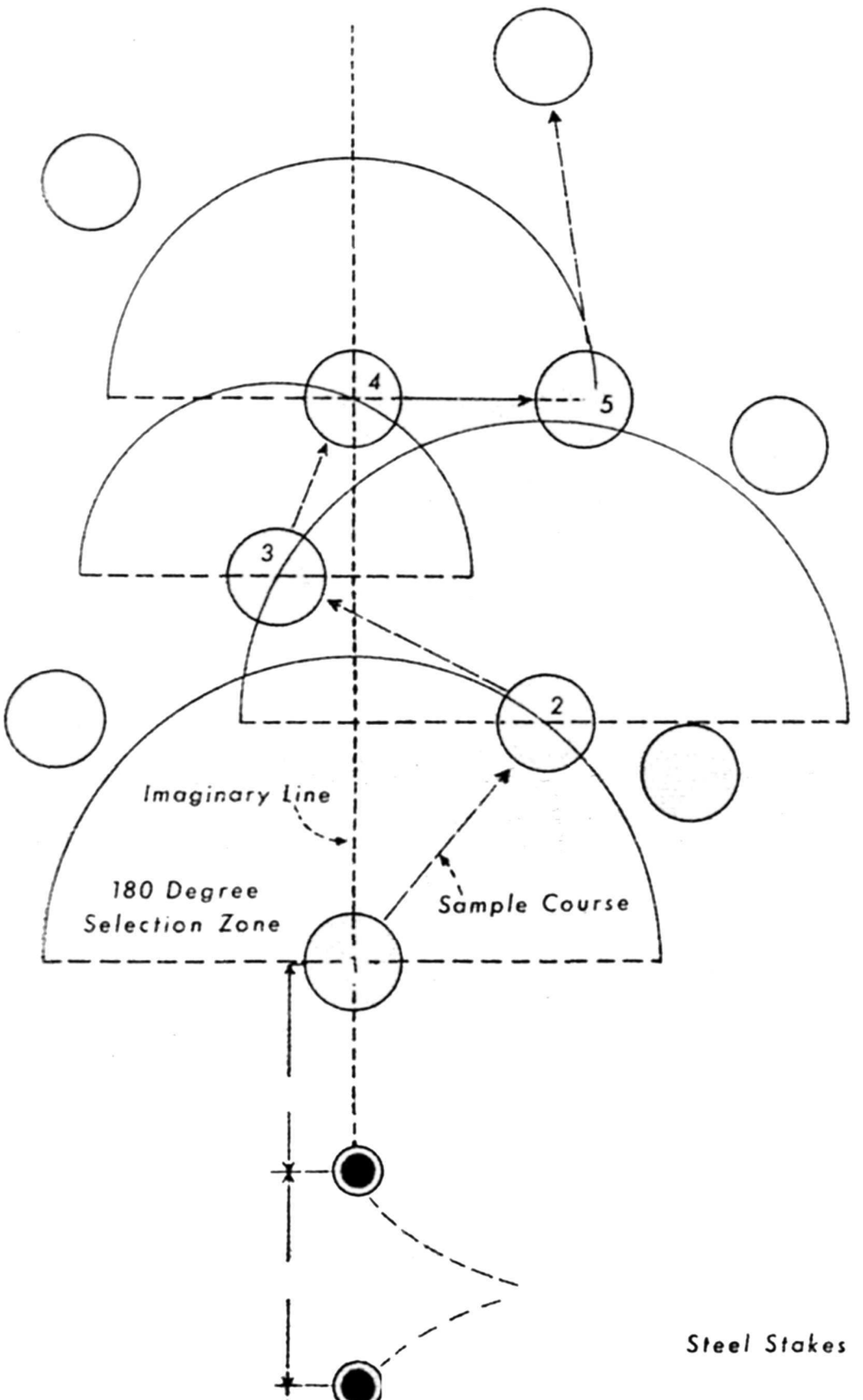

Figure 1. CLOSEST PLANT SAMPLING TECHN.

Leader Use Estimates

Recorded Values	Percentage Ranges
0	
5	1- 9
25	10-39
50	40-59
75	60-89
95	90-100

Availability is gauged for snow conditions on a particular range and the height that young animals of the year can reach with ease. In general, forage availability zones may range from zero to five feet and two to six feet for deer, depending upon winter snow depths. Forage availability zones for such species as elk and moose may range from zero to six feet and two to seven feet. Hedging assignments and leader use estimates are confined to the portions of browse plants within assigned availability zones.

Assignments of the three degrees of hedging (zero to light, moderate and severe) are based upon the length and appearance of the two-year-old wood (previous year's leaders) immediately below current leaders (Figure 2). If more than one degree of hedging is evident in a plant crown, assignments are made on the predominant or average condition.

Two-year-old wood is relatively short and/or strongly altered from the normal growth form in the severely hedged condition (Figure 2C); somewhat longer, but still mostly altered from the normal growth form in the moderately hedged condition (Figure 2B); relatively long and unaltered or only slightly altered in the zero to lightly hedged condition (Figure 2A).

Browse plants are considered to reflect the normal growth form when less than 50 percent of their two-year-old wood (the previous year's leaders) shows clipped ends. A majority of the plants current leaders have extended directly from terminal buds off two-year wood. Alterations from the normal growth form are reflected when 50 percent or more of the two-year-old wood shows clipped ends. Current leaders occur mostly as extensions from lateral buds off two-year-old wood in the moderately hedged condition or as clumped lateral and/or adventitious sprouts in the severely hedged condition.

The length of two-year-old wood reflects the relative vigor of the previous year's leader growth and/or the end effects of use in shortening the previous year's leaders. Used leaders invariably die back from clipped ends.

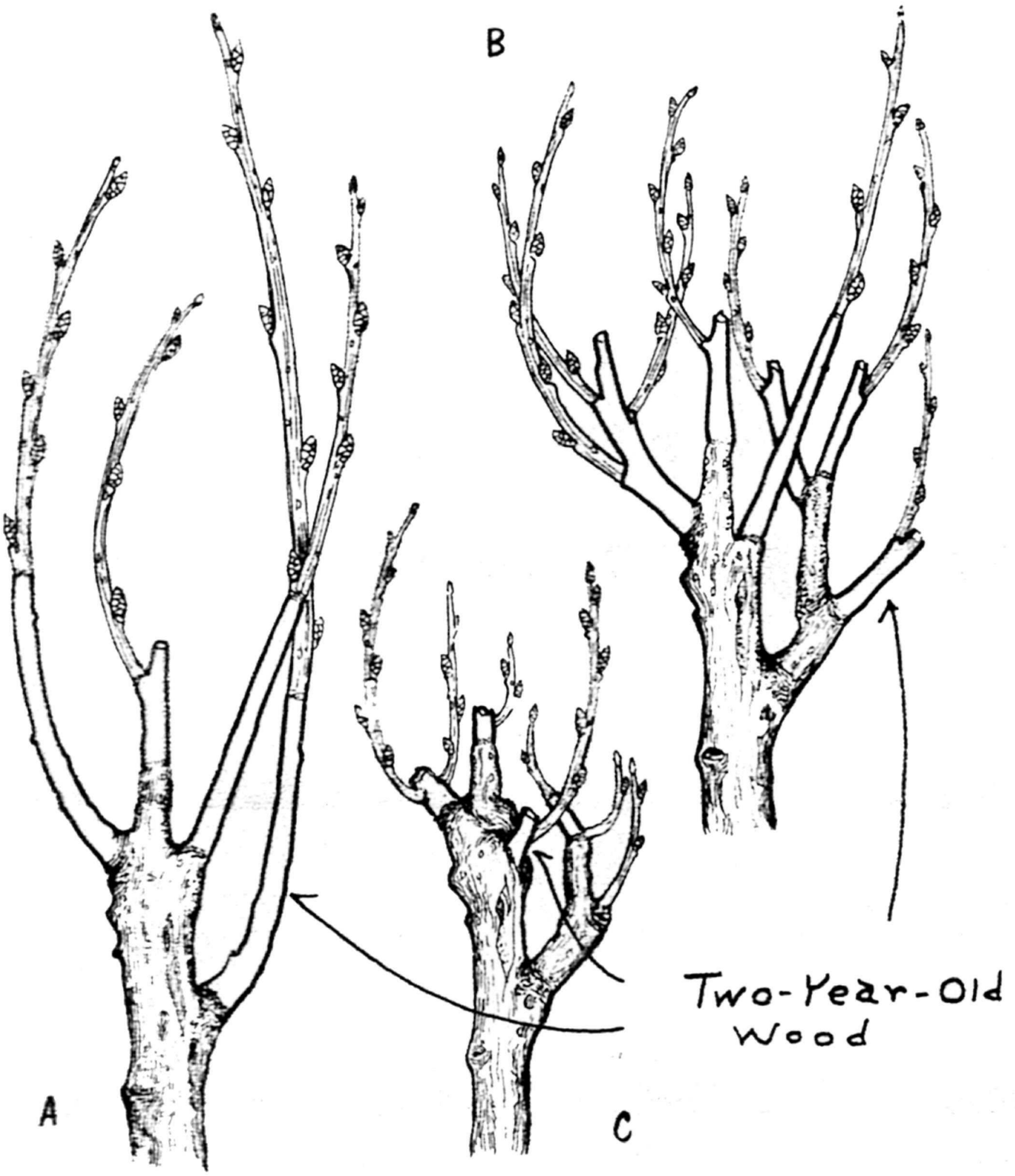

Figure 2. Degrees of hedging. A. Zero to light, B. Moderate, C. Severe.

Assignments of age classes are made by considering browse plants with stems up to 1/8 inch in diameter at the base as Seedlings, those between 1/8 and 1/4 inch as Young and those over 1/4 inch as Mature. In addition, any living plant which has 25 percent or more of its crown surface made up of dead wood is classed as Decadent.

Leader use estimates are based upon the percent of total available leaders showing use. Proficiency in making estimates is gained by visualizing or making sample counts as follows: 1 out of 20 leaders used, 5 percent; 1 out of 4 used, 25 percent; every other leader used, 50 percent; 3 out of 4 leaders used, 75 percent; 9 or more out of 10 leaders used, 95 percent.

5. Sampling procedures.

A "closest plant" sampling technique is used (Figure 1). The sample course is run from the starting point (the first selected plant) to the next closest plant within a 180 degree selection zone, to the next closest plant, etc. Distances are gauged from the centers of plants. When two plants are equally distant, the one closest to the imaginary line extending from the starting point is selected. The 180 degree selection zone may be maintained without the aid of a compass by orienting the sampling course straight up or down a slope or on the contour.

Browse plants falling into the 7 or 8 classes are dot-tallied on the B1 field form (see Appendix). Age class and leader use estimates are recorded in the appropriate columns on the field form for classes 1 through 6.

6. Sampling intensities.

Measurements are obtained from at least 25 key browse plants (7 and 8 classes excluded) on each sample unit. One experienced person may sample and measure plants and record data at only a slightly slower rate than it takes to walk between plants.

7. Compilation of data.

Form and age class data are expressed as percentages. Leader use estimates are expressed as an average. Condition ratings may be assigned to sampled browse plants by the following criteria:

Percent of Severely Hedged or Decadent Plants	Condition Rating
0-10	Excellent
11-20	Good
21-30	Fair
31-50	Poor
50 Plus	Very Poor

8. Analysis of data.

Availability zone assignments confine appraisals of hedging and leader use to the available forage and measure the escapement of plants beyond the reach of animals.

The three degrees of hedging provide a measure of the relative condition of browse plants and assess the short term effects of different intensities of leader use. Since hedging assignments are confined to two-year-old wood, they reflect the effects of use during a previous year or, in the case of low plant vigor, a succession of previous years.

The allowable degrees of hedging which will maintain browse plants in a productive condition will vary. In general, plants under forest canopies or young plants on any site will not tolerate more than light hedging. Mature browse plants receiving direct sunlight will usually tolerate moderate hedging and will even be more productive of forage when kept in this condition. Occasional severe hedging may be tolerated by some browse species, but their forage production will be reduced and they will eventually die if kept in this condition. In practice, vigorous mature plants on winter ranges may be expected to reflect the lightly hedged condition following the occasional mild winter, the moderately hedged condition following most winters and the severely hedged condition following the occasional severe winter.

Age class estimates are considered to measure the establishment, survival and decadence of key browse plants.

Leader use estimates measure the intensity of use on browse plants. Allowable levels of use on vigorous, mature plants on winter ranges may be tentatively set at about 25 percent during mild winters, 50 percent during average winters and 75 percent during occasional severe winters. Adjustments to allow about 50, 75 and 95 percent use in mild, average and severe winters respectively, may be made with some species such as willow. However, the deciding factor for setting allowable use should be the subsequent degree of hedging or plant decadence which results from a particular level of leader use.

Trend interpretations are made by comparing data from different years. Changes in form and age class percentages may be analyzed by employing confidence limits or chi-square tests of significance; changes in average percent leader use values, by a Student's t-test.

9. Modifications.

Estimates of percent of dead wood in plant crowns may be made if a more sensitive measure of plant decadence is desired. Such estimates are used in place of form class assignments on browse species which do not always reflect the three degrees of hedging. Two such browse species are red-stem ceanothus (C. sanguineous) and snowbrush (C. velutinus).

Leader use estimates may be made at the end of a summer livestock grazing season on a big game winter range and again in spring, along with form and age class assignments, to assess the relative effects of use by either class of animal.

Sampling procedures may be modified as follows:

Tags may be wired on initially sampled plants if it is desired that subsequent surveys sample the same plants.

Specified steps or paces, with selections of the closest key browse plant within a 180 degree zone off the toe, may be used to extend the sample course over a desired distance.

KEY BUNCHGRASS CONDITION SURVEYS

1. Equipment needed.

   Clipboard and forms
   Two steel stakes for each sample unit
   Steel rule

2. Period and frequency of surveys.

   Surveys are usually conducted after bunchgrass plants have matured in late summer or fall. Annual surveys are recommended on ranges stocked near or above their capacity.

3. Establishment of a sample unit.

   Two steel stakes are driven about three feet apart to establish a starting point for sampling a representative portion of a key range area. An imaginary line, extending through the stakes into the range site, serves to orient the course followed in sampling plants. An identifying tag is wired to the first stake and sampling proceeds from the second stake along the imaginary line.

4. Measurements.

   The following are obtained as measurements:

   Bunchgrass form class assignments
   An index of bunchgrass density
   Maximum leaf heights or heights of ungrazed plants

   The various form classes assigned to sampled key bunchgrass plants are:

   S - Seedling
   Y - Young
   N - Normal
   HC - Hollow Center)
   CE - Clump Edge)
   D - Dead)

   Suffixes
   R - Recent
   D - Decomposed

The Seedling class is assigned if the basal diameter of a bunchgrass clump is one quarter inch or less; the Young class, if the basal diameter is between one-quarter and one inch in diameter. The other four classes apply to plants with basal diameters greater than one inch. The Normal class is assigned if all portions of a bunchgrass clump have produced current leaves (Figure 3B). The Clump Edge class is assigned if one or more segments of leaves grow on the edge of a clump (Figure 3C) and no segment encircles more than one-half of the clump circumference. The Dead class is assigned if a plant has not produced current leaves. Suffixes are assigned to the Hollow Center, Clump Edge or Dead classes. An "R" suffix is assigned if vegetative structure is evident on the surface of the dead portions of a bunchgrass clump. A "D" suffix is assigned if the dead portions of a bunchgrass clump are lichen covered or decomposed and structureless.

Indices of key bunchgrass density are obtained by measuring distances from a point on the toe to the closest key bunchgrass plant (excluding Seedling and Dead classes) within a 180 degree selection zone off the toe. Maximum leaf or plant heights are taken by placing a rule vertically within a bunchgrass clump. Measurements should be taken to at least the nearest .25 inch.

5. Sampling procedure.

A prescribed or random number (Form G1, Appendix) of steps are taken along the sample course. The closest key bunchgrass plant within a 180 degree zone off the toe of the foot completing each specified number of steps is selected. The form class, density index and height measurement for each selected plant are recorded in the appropriate columns on the G1 Field Form. It should be noted that if a plant is assigned to the Seedling or Dead class it is dot-tallied and the next closest Normal, Hollow Center or Clump Edge plant is then selected for measurement. Density index or height measurements are only taken from plants that are not dot-tallied.

6. Sampling intensities.

Measurements should be obtained from 100 key bunchgrass plants (excluding Seedling and Dead classes) on each sample unit. With one man recording and another measuring, about one and one quarter hours are required to obtain the various measurements from one sample unit.

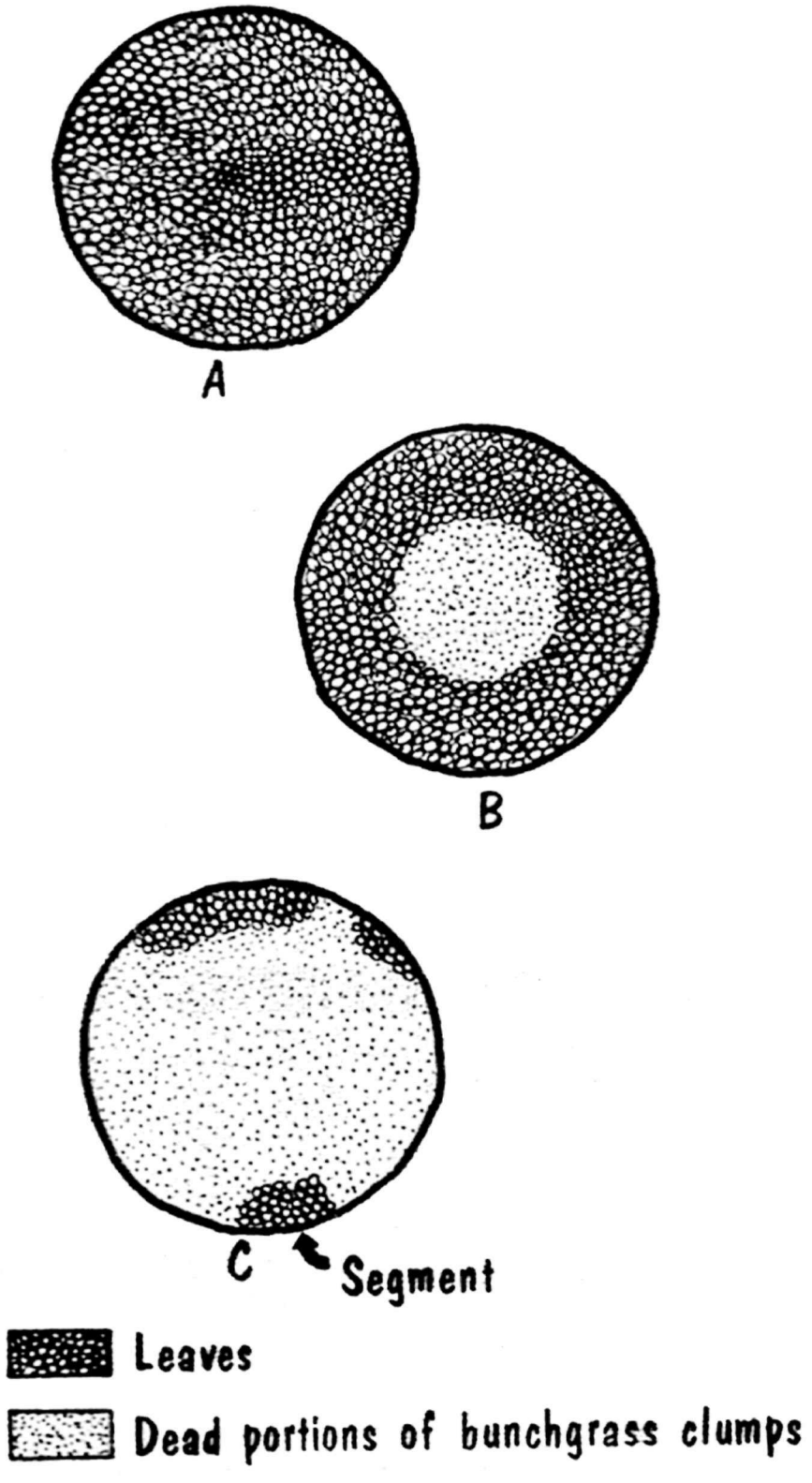

Figure 3. Bunchgrass form classes; A. Normal, B. Hollow Center, C. Clump Edge

7. Compilation of data.

Form class data are expressed as percentages. Density index and height measurements are expressed as averages.

8. Analysis of data.

Hollow Center, Clump Edge and Dead classes reflect conditions where bunchgrass plants have deteriorated in vigor and forage production. Deterioration may be due to plants progressively dying from old age and/or from overuse. The recent and decomposed suffices indicate whether a deteriorated condition has resulted from recent or past use. Percentages of plants in the Hollow Center and Clump Edge classes may be used to condition-class a key bunchgrass range area as follows:

Percent HC and CE	Condition Class
0-20	Excellent
21-40	Good
41-60	Fair
61-80	Poor
81-100	Very Poor

The density index measurement is considered to reflect the relative density of key bunchgrass plants on a site. Maximum leaf or plant height measurements provide an index of relative forage production between years and different range areas.

Trend interpretations are made by comparing data from different years. Changes in form class percentages may be analyzed by employing confidence limits or chi-square tests of significance. Changes in density index or height averages may be analyzed by a "Student's" t-test.

Measurements of key bunchgrass condition may be related to annual utilization measurements to correlate annual use with condition trends.

9. Modifications.

Condition measurements on key bunchgrasses may be supplemented by using Daubenmire's Canopy Coverage Method 1/. In using this method, a 20 by 50 cm. or 1 by 2 foot (formed with a 6 foot folding carpenter rule) plot is put down every third series of steps taken along a sample course. The percent canopy coverage of plant species and percent of

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1/ Daubenmire R., 1959, A canopy-coverage method of vegetational analysis. Northwest Science. Vol. 33, 43-64.

9. Modifications - con't.

bare ground, litter and rock within each of 34 plots is recorded by classes as follows: Class 1, 0-5 percent; Class 2, 5-25 percent; Class 3, 25-50 percent; Class 4, 50-75 percent; Class 5, 75-95 percent; Class 6, 95-100 percent. The midpoints of classes (2.5, 15, 37.5, 62.5, 85 and 97.5) are used to compute average coverage values. Coverage estimates may be made at three to five year intervals in conjunction with key bunchgrass condition surveys. Average coverage values should reflect short term changes in the relative herbage production of plant species and, in conjunction with an analysis of species frequencies on plots, reflect longer-term changes in floral composition.

Density index and height measurements may be made on key forage grasses that do not have the bunchgrass form. Supplementing these measurements by periodically using the Daubenmire Canopy-Coverage Method is recommended. Canopy coverages may be estimated for a key species alone or all plant species.

GRASS UTILIZATION SURVEYS

1. Equipment needed.

   Clipboard and forms
   Two steel stakes for each sample unit
   Region 5 Utilization Chart (Appendixed) or
   Region 1 Utilization Gauge 1/ and steel rule

2. Period and frequency of surveys.

   Surveys are made at the end of a season or grazing period on ranges where key forage species are used by one class of animal or where use by two or more classes of animals occurs at the same time. Two annual surveys, one at the end of each animal's grazing period, are commonly made on ranges where key forage species are used during different seasons.

3. Establishment of sample units.

   The same type of sample unit used for bunchgrass condition surveys is used to obtain utilization measurements.

4. Measurements.

   These may involve either of the following:

   A tally of grazed and ungrazed bunchgrass plants to derive an average percent utilization figure with the Region 5 Utilization Chart. Plants should be significantly utilized (at least 10 percent by weight) to be considered grazed.

   Measurements of grazed and ungrazed grass plant heights for calculating utilization with the Region 1 Utilization Gauge.

1/ Lommason, Tom and Chandler Jensen, 1938. Determining the utilization of range grasses from height-weight tables. U. S. Forest Service, Region 1. 16 pp. Mimeo.

5. Sampling and measurement procedures.

The closest key grass plant within a 180 degree selection zone off the foot completing a specified number of steps is either tallied as being grazed or ungrazed (bunchgrasses only) or measured.

In taking measurements, maximum ungrazed grass heights are recorded to the half inch and grazed stubble heights to the quarter inch. If plant are not evenly grazed, an average stubble height or direct estimate of percent utilization is recorded. Records are kept whether each sampled plant is culmed (seedstalk producing) or culmless.

6. Sampling intensities.

Samples of a minimum of 100 grass plants should be tallied as grazed or ungrazed or measured on each sample unit.

7. Compilation of data.

Percentages of ungrazed bunchgrass plants are converted directly to average percent utilization by reading the Region 5 Utilization Chart.

In using the Region 1 Utilization Gauge, ungrazed plant heights are totaled and averaged if 80 percent of the plants are either culmed or culmless. Average ungrazed plant heights should be computed from at least 20 plants and additional ungrazed plants may have to be measured off the sample unit to obtain an average ungrazed plant figure.

The computed average ungrazed plant height is set on the Region 1 Utilization Gauge. Percent utilization values are then read for each grazed plant stubble height on the culmed or culmless scale, depending upon which class makes up 80 percent or more of the sample. Grazed plant utilization percentages are then totaled and divided by the number of plants in the sample to obtain an average percentage utilization figure for the unit. Plants additionally measured to compute an average ungrazed plant height are not counted in the sample.

Average ungrazed heights and percent utilization of individual plants are computed separately for culmed and culmless plants if neither class represents 80 percent of the sample.

8. Analysis of data.

Allowable levels of utilization will vary with grass species and the season of grazing. In general, allowable utilization on vigorous native grass plants may, until condition trend measurements show otherwise, be tentatively set at about 30 to 40 percent on ranges grazed during the summer, about 40 percent on ranges grazed only during the spring and fall, and about 50 percent on ranges grazed only during the winter. On winter elk ranges, allowable levels of utilization are frequently set at about 25 percent following mild winters, 50 percent in average winters and 70 percent in occasional severe winters. Allowable levels of utilization would be reduced when grass plants are not in a satisfactory condition and improvements in condition are desired.

9. Modifications.

Average percent utilization for bunchgrasses may be obtained by estimating the number of grazed plants in units of ten as follows:

Number Plants Grazed	% Utilization*
1 of 10	5
2 of 10	10
3 of 10	20
4 of 10	30
5 of 10	40
6 of 10	50
7 of 10	55
8 of 10	60
9 of 10	70
10 of 10	80

* Approximate values from Region 5 Utilization Chart

Browse Field Form

Form-B1 Sample Unit No._____

District_____ Area_____ Date_____ Key Sp._____

Location_____

Forage Availability_____ Veg. Type_____

Dot-tally - Form Class 7_____ 8_____ Examiner_____

Plant No.	Form Class 1	2	3	4	5	6	Age Class	Leader Use	Plant No.	Form Class 1	2	3	4	5	6	Age Class	Leader Use
1									26								
2									27								
3									28								
4									29								
5									30								
6									31								
7									32								
8									33								
9									34								
10									35								
11									36								
12									37								
13									38								
14									39								
15									40								
16									41								
17									42								
18									43								
19									44								
20									45								
21									46								
22									47								
23									48								
24									49								
25									50								

Form Classes

Percentages

1 all available, little or no hedging
2 all available, moderately hedged
3 all available, severely hedged
4 partly available, little or no hedging
5 partly available, moderately hedged
6 partly available, severely hedged
7 unavailable } dot-tally
8 dead }

R

Age Classes

S - Seedling
Y - Young
M - Mature
D - Decadent

Leader Use Est.%

0 non-use
5 1- 9
25 10-39
50 40-59
75 60-89
95 90-100

Leader Use Av. _____

REMARKS:_____

Form-G1

Bunchgrass Condition Form

District_____ Area_____ Date_____ Key Sp._____ Plot No._____

Location_____ Veg -type_____

Dot-tally - Seedlings_____ Dead R_____ D_____ Examiners_____

Plant No.	No. Steps	Form Class	Density Index	Max. Leaf Ht.	Plant No.	No. Steps	Form Class	Density Index	Max. Leaf Ht.
1	5				51	1			
2	4				52	5			
3	3				53	4			
4	5				54	1			
5	2				55	6			
6	7				56	1			
7	5				57	4			
8	3				58	4			
9	4				59	5			
10	6				60	2			
11	5				61	5			
12	3				62	3			
13	7				63	2			
14	6				64	7			
15	5				65	2			
16	1				66	1			
17	2				67	7			
18	1				68	7			
19	6				69	1			
20	5				70	5			
21	7				71	5			
22	5				72	5			
23	2				73	2			
24	6				74	2			
25	3				75	1			
26	4				76	5			
27	4				77	6			
28	1				78	3			
29	6				79	3			
30	6				80	2			
31	1				81	4			
32	1				82	5			
33	7				83	3			
34	2				84	6			
35	4				85	5			
36	3				86	2			
37	7				87	1			
38	6				88	5			
39	6				89	1			
40	7				90	4			
41	5				91	1			
42	7				92	1			
43	4				93	2			
44	4				94	6			
45	3				95	6			
46	6				96	4			
47	3				97	1			
48	7				98	7			
49	7				99	6			
50	4				100	7			

Form-G2

Grass Utilization Form

District_____ Area_____ Date_____ Key Sp._____ Plot No._____

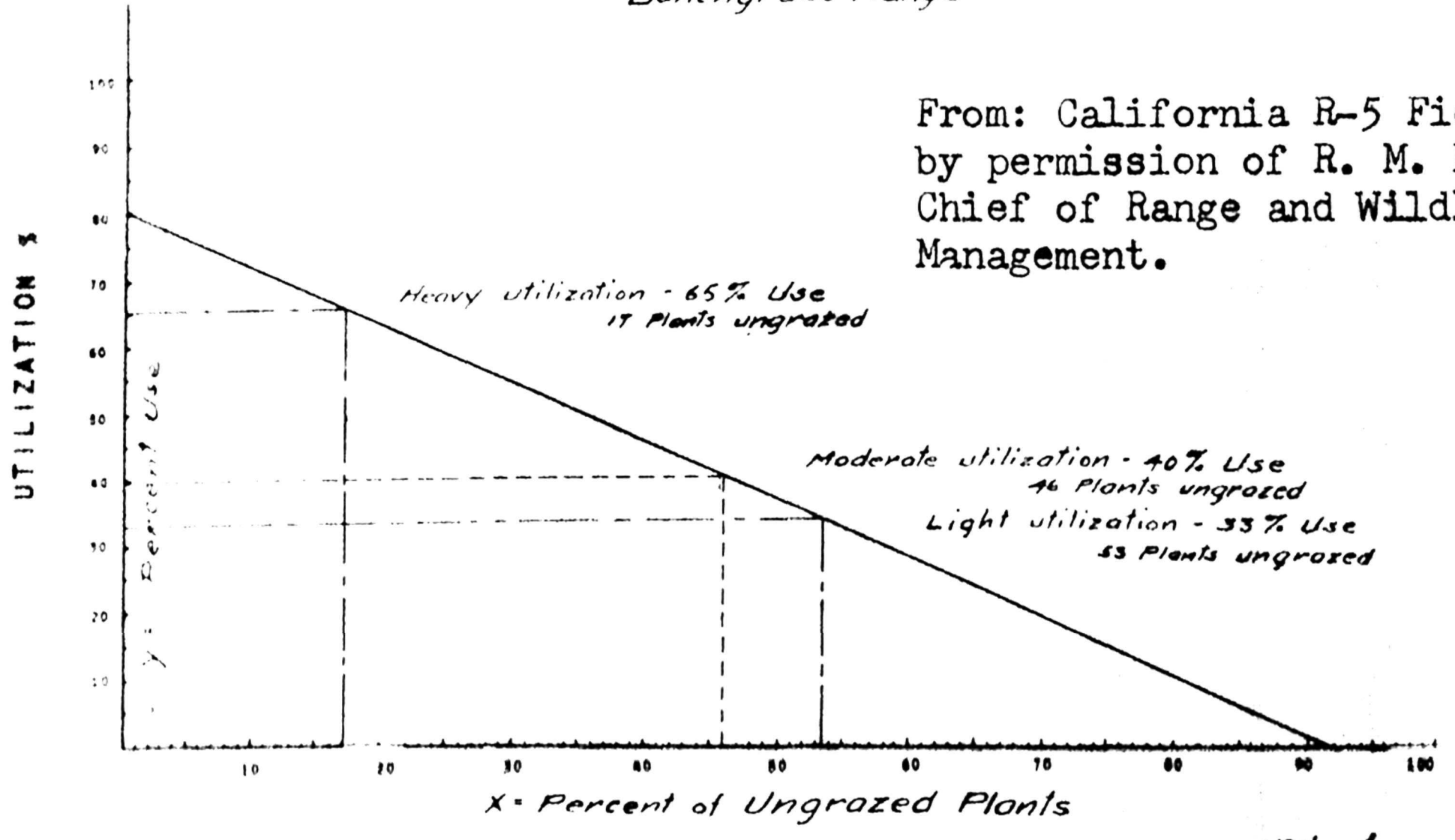
Location_____ Veg. Type_____ Examiners_____

Plant No.	No. Steps	Culms	Ungrazed Heights	Grazed Heights	Percent Util.	Plant No.	No. Steps	Culms	Ungrazed Heights	Grazed Heights	Percent Util.
1	5					51	1				
2	4					52	5				
3	3					53	4				
4	5					54	1				
5	2					55	6				
6	7					56	1				
7	5					57	4				
8	3					58	4				
9	4					59	5				
10	6					60	2				
11	5					61	5				
12	3					62	3				
13	7					63	2				
14	6					64	7				
15	5					65	2				
16	1					66	1				
17	2					67	7				
18	1					68	7				
19	6					69	1				
20	5					70	5				
21	7					71	5				
22	5					72	5				
23	2					73	2				
24	6					74	2				
25	3					75	1				
26	4					76	5				
27	4					77	6				
28	1					78	3				
29	6					79	3				
30	6					80	2				
31	1					81	4				
32	1					82	5				
33	7					83	3				
34	2					84	6				
35	4					85	5				
36	3					86	2				
37	7					87	1				
38	6					88	5				
39	6					89	1				
40	7					90	4				
41	5					91	1				
42	7					92	1				
43	4					93	2				
44	4					94	6				
45	3					95	6				
46	6					96	4				
47	3					97	1				
48	7					98	7				
49	7					99	6				
50	4					100	7				

Av. Util. _____

Utilization Chart

Bunchgrass Range



From: California R-5 Field Guide by permission of R. M. DeNio, Chief of Range and Wildlife Management.

W Wood
4-28-55