UNITED STATES DEPARTMENT OF AGRICULTURE

FOREST SERVICE

RANGE ENVIRONMENTAL ANALYSIS HANDBOOK

Contents

Forest Service Handbook, R-4

*-March 1969
Amendment No. 4-*

R-4 RANGE ANALYSIS HANDBOOK

INTRODUCTION

Range Analysis is a program concerned with the systematic collection and evaluation of data on range resources. It consists of classification and mapping of range types, range suitability, and range condition; provides for the periodic measurement of trend; and for the collection of essential information on range improvements, range readiness, and season of use. All this material is organized for use on maps and graphs. This range information is used in planning and in making decisions in management of the ranges.

The range analysis program is being conducted on a nationwide basis under the guidelines provided in the Forest Service Manual 2212.

This Handbook provides directions for conducting range analysis in the Intermountain Region of the Forest Service. It includes standards and guides which provide the basis for all range analysis conducted within the Region. These guides and standards are based on research findings and on field checks and administrative studies carried on over the last fifteen years. Latest research findings are applied in the development of all standards.

As directed by the Multiple Use-Sustained Yield Act of June 12, 1960, the National Forests shall be administered for outdoor recreation, range, timber, water, and wildlife and fish purposes. We are authorized and directed, as administrators, to develop and administer the renewable surface resources of the National Forests for multiple use and sustained yield of the several products and services obtained therefrom. Multiple use is defined as: "The management of all the various renewable surface resources of the National Forests so that they are utilized in the combination that will best meet the needs of the American people . . . . 'Sustained yield of the several products and services' means the achievement and maintenance in perpetuity of a high-level annual or regular periodic output of the various renewable resources of the National Forests without impairment of the productivity of the land."

Floyd Iverson

FLOYD IVERSON
Regional Forester

UNITED STATES DEPARTMENT OF AGRICULTURE

FOREST SERVICE

*-FSH 2209.21

RANGE ENVIRONMENTAL ANALYSIS HANDBOOK

INTERMOUNTAIN REGION-*

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CHAPTER 10
RANGE ANALYSIS PROCEDURES

Contents

CHAPTER 10

RANGE ANALYSIS PROCEDURES

The range analysis instructions for Region 4 have been organized into Handbook form to facilitate use by the technician and to make necessary additions and revisions easier. Definitions and nomenclature conform to the FSM 2212. Certain sections of the older instructions have been rewritten also.

These instructions and guides have been written under the authority vested in the Regional Forester by FSM 2212.04a which says, "The Regional Forester will develop standards and guides for range analysis."

Personnel doing range analysis work should follow these instructions carefully so as to insure uniform, Region-wide application. If field use brings to light defects in techniques or if improved procedures are discovered, they should be brought to the attention of the Regional Forester for evaluation and approval.

A good job of range analysis and planning depends on full partnership between the technician and the District Ranger. The Ranger must participate to the extent that he becomes thoroughly familiar with the techniques and results of the analysis. The Ranger will then be in a position to give administrative guidance and assume the leadership in the development and application of the plans. He is also responsible for getting permittees to understand and participate in the range analysis.

10.1 – Objectives of Range Analysis. The range analysis procedure is designed to furnish reliable data to develop plans for sustained-yield management of the forage and provide soil stabilization on areas used for grazing.

The objectives of range analysis are:

1. To delineate and designate vegetal types, suitability classes, and condition and trend of vegetation and soils.
2. Estimate the grazing capacity of the range for livestock.
3. To establish bench marks and inspection units to include:
   a. Permanent transects.
   b. Forage production and grazing impact checks.
4. Collect essential information on range improvements, range readiness, and season of use for planning range management.
5. Prepare a planimetric map for each allotment at a 2-inch-to-the-mile scale, showing essential management information.
6. Provide basic information to aid in correlating grazing with other uses of the National Forests.

The 3-Step Method will be used in all range analysis work to determine trend in condition.

11 – RANGE ANALYSIS PROCEDURE. Range analysis embodies the following procedures.

11.1 – Determination of Basic Ecology. A knowledge of basic ecology is essential to:

1. Determine the site potential.
2. Evaluate range conditions.
3. Establish management goals.

In order to be proficient in range analysis work, the examiner must know the principal plant species and their position in the ecological scale. He must know their relative abundance and how they react to grazing pressure. He must know the productive potential of the various sites encountered and the amount of ground cover they are capable of supporting. Site potential can best be determined through examination of isolated areas which have not been grazed by livestock, old exclosures, protected fence corners in cultivated fields, and other natural protected areas.

11.2 – Mapping. Map vegetal types, delineate areas suitable for livestock use, and classify condition of vegetation and soil stability (see Chapters 20 and 40).

11.3 – Determination of Tentative Grazing Capacity. Collect grazing capacity data. This will be based on production determination on primary range (see Chapters 50 and 60).

11.4 – Determination of Trend. Determine trend in vegetation and soil through analysis of existing indicators by 3-Step Method on established permanent bench marks. Trend can also be determined by comparing present conditions with conditions recorded on old range surveys and photo plot transects (see Chapter 80).

11.5 – Development of Management Plans. Formulate management plans which provide for:

1. Improved management practices.
2. Practical range improvements.
3. Proper use under the multiple use concept.

See Chapter 70 and FSM 2212.

12 – ORGANIZATION OF THE RANGE ANALYSIS PROCEDURES. Range analysis will be done in accordance with the following sequence and guidelines. Chapters 20 through 80 will explain in more detail the various study procedures.

12.1 – Become Familiar with the Allotment. This is a very important step. It is in this step that the Ranger should give considerable attention to acquainting the technician with the allotment and grazing problems involved. In familiarizing himself with the allotment the technician will:

1. *Note the major vegetal types.*

2. *Locate and analyze relic areas.* Relic areas are valuable aids in comparing past and present vegetal condition and soil stability. An understanding of relic areas is a valuable aid to range classification. Relic areas also provide a means of determining site potential. When condition standards are available, information from relic areas will support and strengthen them by reflecting local soil and vegetal characteristics. Relic areas can be found on most ranges. A search in the "Unsuitable Not Used" portions of the allotment will often prove productive. Old exclosures or pastures may furnish valuable information. Production and composition observations should be made on representative relic

or near relic areas. In addition, information on soil profile, soil depth and texture should be made a part of the record. (Record information on form R4-2200-13.)

3. *Observe use pattern of livestock and big game.* On mountain rangelands where there is a variety of slopes, exposures, and vegetal types, definite use patterns develop due to uneven distribution of livestock and game on the range. These use patterns can be determined through chip and pellet group counts and forage utilization determination.

Sheep generally prefer the upper portions of slopes, ridgetops, and high open basins. They ordinarily make much greater use of slopes than do cattle. These areas, rather than the canyon bottoms, often provide the key to proper use of the entire allotment.

4. *Observe topography and general soil type.* The topography should be studied and used as a guide to determine range suitability and as a factor in planning livestock management. Natural grazing units, natural barriers, and their effect on distribution should be noted. In addition, soil parent material should be observed along with general observations on soil damage, gully systems, and sheet erosion.

5. *Observe and record water locations.* The location of water on a cattle range is a major factor influencing livestock distribution. It also has a bearing on the suitability of certain parts of the range and influences range management planning. Knowledge of water sources and potential sources should be gained at the beginning of the range analysis work, and the known water shown on the allotment photographs.

6. *Become familiar with the allotment boundaries.* The examiner should know the size and shape of the allotment and its boundaries. Allotment boundaries must be accurately located on the photos by means of a stereoscope. These lines should be checked on the ground to make certain that they conform with the written boundary descriptions.

12.2 – Mapping.

1. *Vegetal types.* Vegetal types will be mapped in the field on aerial photographs on the basis of vegetal aspect. Standard symbols will be used (see Chapter 20, Section 23.1).

2. *Range Suitability.* A determination of the land suitable for livestock use is a major factor in the determination of grazing capacity for domestic livestock. It is mapped concurrently with vegetation typing and range condition classification. Suitability should be based on the best suitability criteria available. Tentative determinations of suitability can be made as the range types are outlined on the aerial photos from vantage points (see Chapter 20, Section 23.2 for complete discussion of suitability.

3. *Range Condition Classes.* Classify range condition based on information obtained from the weight estimate and ocular analysis. This condition classification will be made in accordance with the instructions for rating vegetal and soil condition in Chapter 40. Record the condition classifications on aerial photographs as per instructions in Chapter 30.

12.3 – Weight Estimate or Ocular Analysis as a Basis for Range Condition Classification and as a Check on Suitability.

Each classified area within the allotment except types 7 and 8 must be analyzed by either ocular analysis or weight estimate. At least one in five classifications must be supported by a weight estimate site analysis transect. This proportion of weight estimate transects should be increased where necessary (see Chapter 40 for detailed instructions).

12.4 – Select Permanent Bench Marks on Primary Range. Selected areas within the primary range will be permanently marked and used as bench marks on which measurements and observations will be made to direct management and to guide the manager in his future evaluation of the range. Evaluations to be made on bench mark areas are: (a) grazing impact analysis, (b) determination of proper use, and (c) trend determinations (see Chapter 50, Section 51 for further information concerning bench marks).

12.5 – Firm Up Suitability. Suitability criteria will be applied after each unit or type has been carefully checked by site or ocular analysis. This is known as firming up suitability.

12.6 – Compile Data. Compile data as described in Chapter 70.

12.7 – Estimate Grazing Capacity. Determine tentative grazing capacity in accordance with instructions in Chapter 70.

12.8 – Prepare Management Plans. Prepare management plans in accordance with instructions in FSM Chapter ~~2210~~. 2214

12.9 – Firm Up Grazing Capacity Estimates. Firm up grazing capacity estimate for the allotment by conducting grazing impact analysis on the primary range within the allotment for at least a 3-year period (see instructions in Chapter 70).

13 – PHOTOGRAPHS. Use photographs to clarify and support range analysis data. Some of the more important photo records are:

1. Photos representing range suitability classifications on the particular allotment involved.

2. Photos showing the major vegetal condition classes on the allotment.

3. Photos taken inside and outside range exclosures for comparative study of range conditions.

4. Photos showing proper use.

5. "Before and after" photos to show utilization. Mark and photograph a site just before it is grazed, then after grazing rephotograph the identical site to show degree of utilization.

6. Good contrast photos of used and unused range can be made by photographing utilization cages at the end of the grazing season.

7. On bench marks where 3-Step trend transects are not being installed, photo points can be established. At each photo point, a general view plus one to several closeup photos will be taken. Closeups may follow the procedure as outlined under 3-Step transects in Chapter 80.

Photo points should be permanently located with rock piles or steel posts. A record of each point should be made (see Chapter 80).

CHAPTER 20

MAPPING

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CHAPTER 20

MAPPING

*-21 - ANALYSIS MAPPING. A good map is basic and essential in the range environmental analysis program. The following guides apply to the mapping procedures:

1. A map will be prepared for each range allotment, including those areas from which grazing may currently be excluded or deferred. The map will show vegetal types, range areas suitable and unsuitable for domestic livestock grazing, and range condition and trend.

2. Field mapping will be done on aerial photographs. Completed photos will be sent to the Regional Office Division of Engineering for transfer of data to a planimetric base.

3. The Division of Engineering may, in turn, contract transfer work back to designated National Forests or to private contractors, as needed.

4. Except where special need exists, mapping will be confined to allotments having photo coverage and prepared planimetric base maps. The Forest Supervisor and/or the District Ranger will designate the allotments to be analyzed, on a priority basis. A complete analysis will be done on each allotment as it reaches top priority.

5. Engineering personnel will set up priorities for preparing the completed allotment maps. This priority is based on a "first come, first served" basis unless special priorities are assigned.

22 - PREPARATORY WORK. The following preparatory work should be done in the office prior to the field season:

1. Assemble maps of the allotments to be analyzed. From flight line indices, determine the aerial photos needed to obtain complete allotment coverage. If aerial photos are not available on the Forest, order photos for full coverage sufficiently early to assure delivery before the field season. Photos with semi-matte finish should be specified, since they are easier to write on with either pen or soft pencil than are glossy prints.-*

*-2. Arrange allotment photos in flight lines. Block work areas in red on alternate pictures, by use of a stereoscope or by using several reference points on each side of the work area. (See Exhibit 22 for example.)

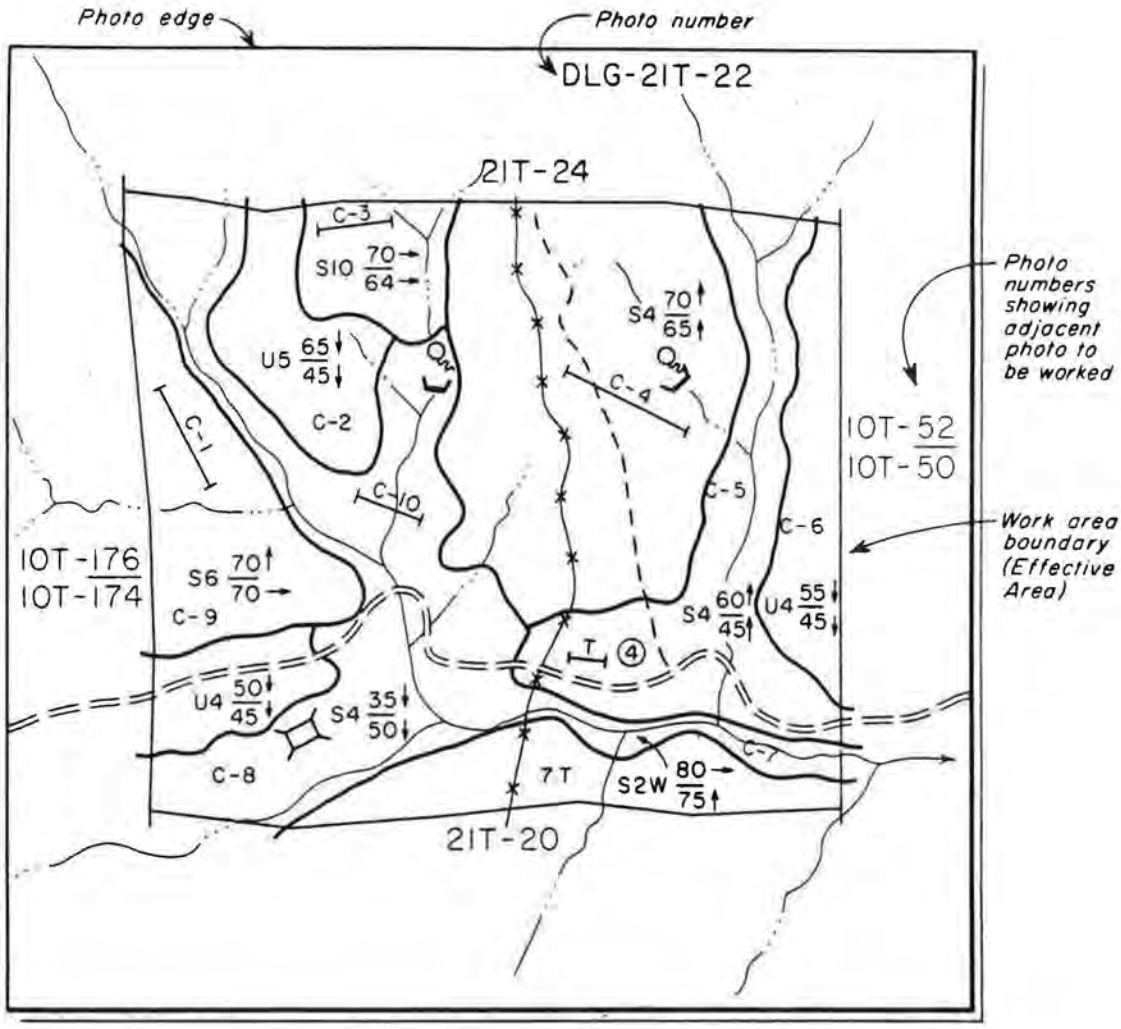
3. Accurately locate allotment boundaries on photos by use of a stereoscope. Indicate boundary with a solid green line.

4. Accurately locate on the photos, by pinprick and appropriate symbol, those existing range improvements that have been previously photo-identified on other photos. Those improvements whose location has not yet been photo-identified may be indicated on the photos in pencil, for later on-the-ground confirmation.

5. Locate on the photos, by pinprick, all previously recovered section corners.-*

Exhibit 22

EXAMPLE OF MAPPING ON AERIAL PHOTOGRAPHS



*-23 - FIELDWORK. A map will be made of each allotment, showing the types of vegetation, the areas suitable and unsuitable for use by domestic livestock, and the condition and apparent trend of the soil and vegetation. Symbols showing range improvements not already plotted will be entered on the field photos in black. Proposed improvements, areas with a seeding or spraying potential, and areas with noxious farm weeds may be shown on a frosted overlay attached to the aerial photos. The frosted overlays used for this purpose become a part of the allotment analysis.

A solid black line on the photo will be used to delineate range suitability, vegetation type, and range condition classes. A 3-unit symbol will be used to denote suitability, vegetation types, and range condition. Trend will be shown with arrows. Generally, the minimum area delineated will be 20 acres. Exceptions are meadows, other high forage-producing lands, reseeded units, relic areas in good or excellent condition, or critical watershed areas. These will be mapped to a minimum size of five acres. (See Exhibit 22 for example.)

Some lands are so broken up with islands of rock, dense timber stringers, or other physical features, that the job of delineating range suitability or vegetational type is often difficult and impractical. In such cases, it is permissible to map the entire area in one category and to estimate the percentage in each classification. This technique should be used only when the intermixed classifications are contrasting or significantly different. If used, a separate writeup and condition rating must be prepared for each classification within the type. The resulting symbol will appear as follows:

$$\begin{array}{lll} 90\% & 7t & \frac{65}{80} \rightarrow \\ 10\% & S2w & \end{array}$$

The kind of livestock using an area will be considered in determining range suitability. On common use ranges the instructions in Section 23.5 will be followed.

23.1 - Vegetation Types. The types of vegetation will be mapped in the field on aerial photographs, on the basis of vegetal aspect. Standard symbols developed for range surveys will be used. These are:

1 - Grassland - Includes all grasslands other than meadow.

2w - Wet Meadows - Are characterized mainly by sedges, rushes, and water-loving grasses which remain wet or moist throughout the summer. Soils are poorly drained.

2d - Dry Meadows - Are dominated generally by grasses and occur as moist meadowlike areas in the spring but generally become dry by midsummer. Soils are moderately well drained.-*

*-3 - Perennial Forbs - Includes those untimbered areas where perennial forbs predominate.

4 - Sagebrush - Includes untimbered lands where sagebrush or rabbitbrush dominate the area. Where it is necessary to separate tall and low sagebrush communities, they may be designated 4T and 4L respectively.

5 - Browse-Shrub - Includes untimbered areas where browse, except sagebrush or similar species, gives the main aspect to the type: such as oakbrush, mountain mahogany, bitterbrush, willow and ceanothus.

6 - Coniferous Timber - Includes all areas where coniferous types dominate the aspect, provided there is a sufficient amount of forage understory to be suitable for grazing.

7 - Heavy Timber or Other Types - Includes those areas with an inherent lack of forage and contributes little or nothing to support of livestock or big game. Where natural forage production is less than 50 pounds dry weight per acre, it would be classified as 7. Dense and down-timber stands and heavy brush patches will make up most of this category. It is classed as nonrange.

8 - Barren - Includes all areas on which any type of vegetation is inherently absent or very sparse. Rock slides, boulder fields, and recent lava flows are examples. This type is classed as nonrange also.

9 - Pinyon-Juniper - Includes all areas where pinyon or juniper gives the general aspect.

10 - Broadleaf Trees - Includes all range in deciduous timber. Aspen is the principal type in Region 4.

20 - Cultural Treatment Area - Includes those areas which have received successful cultural treatment by any of a variety of techniques including, but not limited to, plowing, drilling, spraying, chaining, pitting, and burning. Areas where the cultural treatment is considered to be a failure are not included in this classification but are typed according to their present cover aspect.

23.2 - Mapping Range Suitability. All ranges being analyzed will be mapped as suitable or unsuitable for livestock grazing.

1. Suitable Range. Suitable range is that area which is accessible or can be made accessible to livestock, produces forage or has the potential to produce forage,-*

*-and can be grazed on a sustained-yield basis without damaging watersheds or other resource values. Suitable range will be classified as primary, secondary, closed, or transitory, on the basis of existing management systems and improvement facilities. The following symbols will be used:

S - Primary Range. Primary range is that part of the suitable range which livestock naturally prefer to use, which is accessible, and which can be used without damage to the soil resource of the area itself or adjacent areas. Normally it includes the forage-producing areas that are readily accessible and have available water. Primary range may be in a depleted condition due to past overuse, in which case it may provide little current forage.

C - Suitable Range Closed. Land suitable for livestock grazing which has been closed to livestock use. Administrative pastures, recreation areas, municipal watersheds, key game range, and similar areas which have been closed to grazing will fall in this classification.

Ⓢ - Secondary Range. This is land suitable for livestock use from the standpoint of slope, soil stability, and forage production, but which is often grazed very little or not at all because of management or improvement deficiencies. In many cases, it is used only after primary range has been properly grazed. Grazing capacity will not be assigned to secondary range. Secondary range may be made primary range by overcoming deficiencies which limit or prevent use.

T - Transitory Range. This is land, normally timbered, which has been made temporarily suitable for grazing, through fire or logging and which will eventually revert back to timber. Grazing capacity and suitability will decline as forest cover is re-established. Because of its temporary and declining nature, grazing capacity for this classification will be computed periodically and will be summarized apart and separate from the grazing capacity of the allotment as a whole. The amount of temporary use to be allowed will be determined on the basis of availability and effect on timber reproduction, soil stability, and wildlife use, rather than on condition of the range from a forage-producing standpoint. Special guides and standards will be developed for this type of range, as needed.

Sites which have been devoid of trees for many years and will not produce trees without planting will be handled the same as any other permanent range type. -*

*-2. Unsuitable Range. Unsuitable range is that area which has no value for, or should not be used by livestock because of inherently unstable soils, steep topography, barrenness, dense timber, or inherent lack of forage. Unsuitable range will continue to be unsuitable regardless of the management and/or development changes applied.

The following symbols will be used in mapping unsuitable range:

U - Unsuitable Range Used.

N - Unsuitable Range Not Used. Use of less than one cow day per acre will be classed in this category.

7T - Heavy timber types which, in their pristine state, produce less than 50 pounds of available dry forage per acre.

7 - Types, other than heavy timber, which contribute less than 50 pounds of available dry forage per acre to either domestic livestock or big game.

8 - Barren areas (see description in Section 23.1).

The last three categories above are commonly termed nonrange.

Areas of water surface need not be classified for suitability, since their nature is already shown by standard symbol on the base planimetric map.

23.3 - Mapping Range Condition. Range areas will be rated into five condition classes - excellent, good, fair, poor, and very poor. A numerical rating of 1 to 100 will be used to designate condition. 81-100 is excellent; 61-80, good; 41-60, fair; 21-40, poor; and 20 or under, very poor. Field sheets used in determining vegetal and soil conditions should be preserved. Rating will be shown on both the photos and maps. For example $\frac{60}{40}$ --the number above the line represents the vegetal condition; the number below the line, soil condition. This $\frac{60}{40}$ rating would indicate the vegetation in fair condition and the soil in poor condition. Condition in Region 4 is determined by the lower of the two ratings; therefore, the overall classification for this type would be poor.

In general, condition ratings will be made for all areas now being used by livestock and all areas given a secondary range classification, whether currently being used or not. Other areas will be rated as to condition, only where it is necessary for determining the proper suitability classification. Condition ratings need not be made for transitory range areas.

Areas that are obviously inaccessible will need only a cursory examination. See Chapters 30 and 40 for details on condition classification.-*

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*-23.4 - Mapping Apparent Trend. Apparent trend in soil stability and vegetation will be judged separately for each area on which condition has been determined. The following symbols will be used to denote apparent trend:

↑ Up; ↓ Down; → Not Apparent.

Apparent trend will be judged using the trend guides contained in Exhibit 41-M, Chapter 40.

23.5 - Mapping Suitability on Common Use Allotments.

1. Make the basic classification of suitability for cattle. This data will be inked in black on the completed photos.

2. Map sheep suitability on the same photo. Additional lines required for sheep suitability will be shown in brown. Where a sheep symbol is required, write it in brown under the cattle symbol. For example, the symbol for the classification for cattle might be $N5\ \frac{60}{50}\ \rightarrow$. This would indicate a browse range "Unsuitable Not Used" for cattle, fair vegetal condition, and fair soil condition, trends not apparent. This same area for sheep might be typed $S5\ \frac{60}{50}\ \rightarrow$. This would indicate it suitable for sheep. For the combined classification show a brown "S" under the "N"; thus, $\begin{matrix} N \\ S \end{matrix}5\frac{60}{50}\ \rightarrow$. -*

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*-24 - FIELD MAPPING SYMBOLS.

Range Suitability

S - Primary Range

C - Suitable Range Closed

(S) - Secondary Range

T - Transitory Range

U - Unsuitable Range Used

N - Unsuitable Range Not Used

Vegetational Type

1 - Grassland
2w - Wet Meadows
2d - Dry Meadows
3 - Perennial Forbs
4 - Sagebrush
5 - Browse-Shrub
6 - Coniferous Timber
7T - Heavy Timber
7 - Other
8 - Barren
9 - Pinyon-Juniper
10 - Broadleaf Trees
20 - Cultural Treatment Area

Range Condition

81-100 - Excellent - E

61-80 - Good - G

41-60 - Fair - F

21-40 - Poor - P

Under 20 - Very Poor - VP

Trend

↑ Up Trend

↓ Down Trend

→ No Apparent Trend

Examples:

U1 $\frac{35 \rightarrow}{36 \downarrow}$ - Unsuitable grassland range being used, with the vegetation in poor condition and with no apparent trend, and with the soil stability in poor condition with a downward trend.

S2w $\frac{65 \uparrow}{62 \rightarrow}$ - Primary suitable wet meadow with the vegetation in good condition and showing an upward trend, and with the soil stability excellent and with no apparent trend.

7 - Heavy timber or brush (suitability and condition ratings will not be made for vegetation types classified as nonrange).-*

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*-The following symbols will be standard for mapping on aerial photos:

Basic Typing Units		Color
Allotment Boundary		Green
Type Boundary		Black
Range Classification	S4 $\frac{62}{4E}$ → ↓	Black
Permanent Streams		Blue
Springs		Blue
Site Analysis Transect	C-4	Red
Ocular Analysis	C-5	Red

For existing range improvements and permanent study locations: use "Standard Map Symbols for Range Administration" to show existing range improvements, permanent study locations, and other features. (See Chapter 20, Section 26.) These will be shown in black on the photos.

Note: Information shown on photos in colors other than red will be transferred to the map. Information shown on photos in red will not be transferred to the map.-*

*-25 - COMPLETION OF THE MAP

25.1 - Steps for Completion of the Map. After mapping has been completed on aerial photos, the following steps will be necessary to complete the maps:

1. Check to see that symbols are complete and type lines match where they join at the boundaries of the photo work areas. Use a stereoscope to make certain that allotment boundaries and other important features are properly located on the photos. Ink the photos, as they are to be kept as permanent working records.

2. Where private land is involved, the known section corners, land monuments, mining claim monuments, and private property corners should be pinpointed on the photos. Definite photo-identified locations are of great help to Engineering in delineating the private lands, and as many as possible should be provided.

Features that cannot be plainly identified on aerial photos such as roads, trails, spring water developments, wells, campgrounds, and powerlines, should be delineated or indicated thereon.

3. Requests for range analysis mapping will be processed through the Regional Office, using the following procedure:

a. Complete form R4-7100-63 (8/67) and send two copies, plus all the materials listed on the form. For common use range indicate under "Special Instructions" whether separate maps are desired for sheep and cattle or if a single combination map is desired.

b. Send sufficient photos for complete stereocoverage of the allotment. Check the ends of the flight lines to assure stereocoverage in these areas. Send a small-scale map, usually 1/4 inch = 1 mile, on which the allotment boundary is delineated.

c. Upon receipt of form R4-7100-63 (8/67), the Division of Engineering will forward the carbon copy to the Division of Range Management and will ordinarily plan to work on projects in the same sequence as they are received.

d. If there is need for maps to be produced by a certain date, this should be stated on the form under "Special Instructions," along with a justification statement of why a special priority should be given the work. Division of Range Management will be responsible for approving or disapproving this special priority and for notifying the Forest and the Division of Engineering accordingly.-*

*-e. If the District Ranger anticipates a need for the aerial photos between the date of submission to Engineering and the date the photogrammetric work can be started, the following alternate procedure will be followed:

(1) Submit the completed form R4-7100-63 (8/67). After the heading "The Following Photo Coverage," write the following statement: "Photos are needed on the Forest. Please return immediately."

(2) The Division of Engineering will enter the allotment name on its priority list and will advise the Forest of the estimated date the aerial photos will be needed for data transferring.

4. The Photogrammetry Section, Surveys and Maps Branch, Division or Engineering, has responsibility for transfer of the range analysis data from the photos to a stable base map, in conformity with Class C map standards. The sequential procedure will be as follows:

a. A priority number will be assigned to the allotment corresponding to the sequence in which it is received. This number will be entered on a priority list. A project file will be established for correspondence and materials pertaining to the allotment.

b. The photos will be laid out and inspected for type ties, completion, and sufficiency of stereocoverage. If corrections to the type lines are required, or if additional photos are needed to complete stereocoverage, they will be requested from the Forest.

c. From the allotment boundary sketched on the small-scale (1/4 inch = 1 mile) map, it will be determined which planimetric base map quadrangles (scale 2 inch = 1 mile) are needed for the allotment base map. Cronaflex positive prints of these quadrangles will be obtained and assembled to produce a cronaflex positive base map covering the allotment. A legend will be spliced into this map, after which a second cronaflex reproduction will be made of the entire map. The legend will contain spaces for indicating by whom and when the fieldwork and KEK transfer work phases were done. The transfer of the range-type data will be made on the first cronaflex positive of this map (see "d" below). The reproduced copy will be used for making base map corrections and additions, and for reproduction of the final composite map (see "i" below).

d. The next step will be the photogrammetric transfer of data from the aerial photos to the cronaflex positive base map. The Photogrammetry Section will arrange for accomplishing this work by the Regional Office KEK Unit, by Forest Units, or by commercial firms. The following procedure will be used.-*

*-(1) The photogrammetrist will examine the reverse side of the photos for diagrams of photo-identified land corners, bench marks, or other cadastral points. Each of these will be transferred to the base map and shown in ink as a cross.

(2) The interior planimetric orientation will be completed and scale adjusted to the planimetric features.

(3) The following information will then be transferred photogrammetrically from the aerial photos to the first cronaflex positive base map:

(a) Allotment boundaries

(b) Range-type boundaries

(c) Springs

(d) All existing range improvements and permanent study locations. The symbols for these features are shown on pages 24--2 and 26--1 of this Handbook and in the legend for base maps.

(e) Changes in the planimetry that are marked on the photos in colors other than red. These could include such features as roads, trails, fences, or private land boundaries.

(f) Photogrammetric transfer of natural drainages to the map will not be necessary unless there is an obvious error in the location on the base map. If the base map is found to be in error, the correct location will be plotted on the map, then colored with a blue pencil, and the original alignment will be removed by scratching the emulsion from the base map.

(4) Allotment boundaries will be inked on the cronaflex base map using a line width of 0.6 mm, which can be drawn with a No. 2-1/2 Rapidograph pen. All other information will be inked with a line width of 0.2 mm, as drawn with Rapidograph No. 00.

(5) Range classification will be lettered legibly and in the sequence as illustrated in the examples under Paragraph 24. Lettering will be done so as to be easily read when the map is oriented with north at the top or away from the observer. If there is not sufficient room to place the classification within the area, it will be placed just outside the area in a relatively open space, with a small arrow extending into the type area. -*

*-(6) When one range suitability designation appears on the photographs in black and another in brown, both will be inked in black on the transfer sheet. The designation appearing in brown on the photographs will be lettered on the transfer sheet immediately below that which appeared in black on the photographs. If a Forest requests separate maps for sheep and cattle, the appropriate designations will be drafted on separate cronaflex positives. Otherwise, the double symbol will be drafted on a single cronaflex positive (see Section 23.5).

(7) The legend will be filled in freehand on the transfer sheet by the KEK operator doing the transfer work.

(8) If the transfer work is done by a Forest unit or by a commercial firm, the materials, including the photos, will be returned to the Regional Office Photogrammetry Section, after the above steps.

(9) If additions or corrections to the land net are necessary, they will be made in pencil on the transfer sheet by the Map Edit Unit.

(10) The transfer work will be checked for accuracy, clarity, and completeness. The accuracy must meet Forest Service Class C standards.

e. The aerial photos submitted for some allotments contain blue delineations along some streams to indicate whether they are continuous or intermittent. For other allotments, no blue delineations appear on the photos. On the planimetric base map used for the transfer work, all streams appear as solid lines. These will be treated as follows:

(1) If any blue delineations of streams appear on the photos for the allotment:

(a) Where blue delineations show streams as permanent, the streams will be left as solid lines on the map.

(b) All other streams will be shown on the map as intermittent by scratching emulsion from the map to leave three dots at intervals, as indicated in the explanation of format. This applies both to streams shown in blue as intermittent and to those from which the blue delineation has been omitted.

(2) If no blue delineations appear on the photos, all streams will be left as solid lines on the map.

f. Three black-and-white prints of the rough draft map will then be obtained and marked "Preliminary, unverified, and unedited copy." These prints will be sent to the Forest for their use in indicating corrections.-*

*-g. Corrections, additions, and deletions will be made on the B/W prints of the map and on the photos by Forest personnel using the following procedures:

(1) Corrections will be made on the rough draft map in colored pencil or ink, using red for additions and blue for deletions. This applies to all types of corrections, including range-type data and drainage symbols.

(2) The corresponding corrections to range-type symbols and type lines will be made on the aerial photos in black ink.

(3) If the locations and symbols for permanent and intermittent streams on the rough draft map do not correctly represent these natural water features, corrections will be delineated on the photos in blue.

(4) Additional geographic names can be added, or changes in present names can be made, on range analysis maps at the request of a Forest. If these changes are desired on the 2" planimetric quadrangles, the procedure outlined in FSM 7147 will be followed.

(5) The complete set of aerial photos, including corrections and one copy of the corrected rough draft map, will be returned to the Regional Office, Division of Engineering.

h. The aerial photos and B/W print of the map containing the corrections will be routed to the Photogrammetric Process Unit, where appropriate action will be taken as follows:

(1) If additional KEK transfer work is required, it will be scheduled in the same sequence as the allotments are received for correction. After the KEK work is completed, the corrected B/W print and both cronaflex positive copies of the map, together with the photos, will be sent to the Cartographic Section for final drafting.

(2) If no additional KEK work is required, the corrected B/W print and both cronaflex positives of the map will be sent to the Cartographic Section for final drafting.

(3) Drafting in final form will be done in accordance with the attached specifications.

i. The scribe-coat sheet containing the scribed range analysis data as produced in the drafting process, the two cronaflex copies of the base map, and the corrected print of the rough draft map will be returned to the KEK Unit, Photogrammetry Section, for final review. After final review, a-*

*-cronaflex positive composite and 11 B/W prints will be obtained and the following distribution will be made:

(1) The cronaflex composite positive of the map, 10 final B/W prints, and the original photos will be returned to the Forest.

(2) One final B/W print of the composite map will be sent to the Division of Range Management.

j. The allotment will then be removed from the priority list and the remaining materials will be sent to the Maps and Photos Unit for filing in the inactive file.-*

RANGE ENVIRONMENTAL ANALYSIS HANDBOOK

*-Exhibit 25-A

SPECIFICATIONS FOR DRAFTING RANGE ANALYSIS ALLOTMENT MAPS

1. Range Allotment Base Map

   a. The following will be inked on the base map according to the scribing standards for Forest Service 1:31,680 planimetric maps and the range allotment base map line width conversion chart:

      (1) Section numbers. (A section will be identified if more than 50 percent of it falls within the map border.) As a section number guideline, only section numbers 1, 6, 31, and 36 will appear on the transfer sheet unless a half township appears on the map. In this case, all sections within the township will be numbered.

      (2) All other items listed in the scribing and inking standards under "items that may be on transfer sheet, but will be inked on the base map." All geographic names which do not completely appear on the base map will be deleted unless shown on the transfer sheet. All deleted planimetry will be re-inked; e.g., roads, streams, and section lines.

2. Range Allotment Overlay

   a. The range analysis data from the cronaflex positive transfer sheet will be scribed on a stable base scribe coat.

   b. The following will be scribed on the overlay sheet, according to the attached scribing standards for range allotment analysis overlay:

      (1) Range allotment boundaries, exactly as shown on the transfer sheet, with the following exceptions:

         (a) When county, state, or National Forest boundary lines coincide with range allotment boundary lines, the county, state, or National Forest boundary lines take precedence.

         (b) Range allotment boundary lines must not overprint roads or drainages. If the range allotment boundary closely parallels these features, it will be moved 0.05 inches outside the feature so as to encompass it.

      (2) Range allotment type lines, scribed exactly as shown on the transfer sheet.-*

*-(3) Range allotment type designations, in the sequence indicated by the examples in Chapter 20 of the Range Environmental Analysis Handbook page 24--1 entitled "Field Mapping Symbols."

(4) Symbols and circled lettering, in their exact location.

(5) Other items listed in the instructions for scribing range allotment analysis overlay data.

(6) Registration ticks, e.g., stream intersections and road intersections, will be scribed in two corners diagonally opposite each other.-*

*-Exhibit 25-B

SCRIBING STANDARDS FOR RANGE ALLOTMENT ANALYSIS OVERLAY
JULY, 1967

NO.	FEATURE	SYMBOL	LETTERING
1	Allotment Boundary	1½" — .030	
2	Type Line	.006	
3	Condition Classification	S4 $\frac{42}{68}$	80 Vert Cap.....006
4	Water Development	Wings point down stream. Actual Size	
5	Reseeding	(RE) .006	80 Vert. Cap.....006
6	Sprayed Area	(SP) .006	80 Vert. Cap.....006
7	Bench Mark-Number	② .006	60 Vert Cap.....006
8	Permanent Camera Point	(CP) .006	80 Vert. Cap.....006
9	Permanent Trend Transect	Length of transect will vary. .006	60 Vert. Cap.....006
10	Photo Center	● 1/8" CIRCLE	60 Vert. Cap.....006
11	Study Enclosure	Size of enclosure will vary. 006	

Instructions For Scribing Range Allotment Analysis Overlay Data.

1. Allotment Boundary
   a. Allotment boundary will be shown on Transfer Sheet using a 2½ Rapidograph.
   b. Where allotment boundary follows roads and streams, it will be displaced not more than $\frac{1}{20}$ of an inch to the outside of these features.
   c. Forest boundaries and state boundaries will serve as allotment boundaries where they concide.
   d. Scribing of allotment boundary over creek names, etc. will be acceptable due to halftone printing of allotment data.
   e. Allotment boundary will not deviate from that shown on the Transfer Sheet, except where it will be displaced as in subitem b above.

2. Type Lines
   a. Type lines will be shown as a continuous black line on the Transfer Sheet.
   b. Type lines will be scribed as a continuous line.
   c. Type lines will be followed as shown on the Transfer Sheet without any deviation or displacement.
   d. The draftsman should not attempt to continue type lines that end abruptly or show breaks.

3. Type Designation
   a. On maps where the typing is intricate and congested, it will be acceptable to use a 60 Le Roy guide with a .006 point.
   b. Where possible, types will be scribed within type boundaries unless area is too small. If so, they may be arrowed by placing adjacent to typed area and crossing as few type lines as possible.
   c. Types should not be superimposed over Base Map features or other information which would tend to make them illegible.
   d. All types will be lettered horizontal and positioned to read from the South.

4. Water Development
   Wings of symbol will point downstream or toward nearest drainage.*

3 thru 8, 10 & 11
These items will be placed in exact position on overlay as shown on Transfer Sheet and will be lettered horizontally, positioned to read from the South.

9. Permanent Trend Transect
These will be placed exactly as shown and a "T" or Number will be centered directly above.

Items that may be on Transfer Sheet, but will be inked on Base Map.

1. Roads
2. Trails
3. Springs
4. Fences
5. Alienated Land
6. Names

— Refer to Forest Service 2-inch planimetric scribing standards and conversion chart, for inking instructions

7. Map Border
Line weight will be comparable to Rapidograph No. 1 point.

8. Drainage
a. Perennial
This drainage will be indicated on the Transfer Sheet as a solid line and will not be changed on the Base Map.

b. Intermittent
This drainage will be shown with a dash and three dot symbol (– ∼ –) on the Transfer Sheet and will be changed on the Base Map. The length of dash will not exceed 1½ inches.

c. Brown Line
This indicates relocation of drainage. Re-ink drainage on Base Map in exact position.

d. Perennial and intermittent drainage classifications will only apply within allotment bdy.

9. Title
a. Forest, district, and allotment names will be inked with 140 LeRoy guide and No. 1 pen.
b. Author and date will be inked with 80 LeRoy guide and No. 000 pen. Last names or initials will be accepted when short of space.
c. Date printed will be left blank.

10. Section Numbers
They will be centered within section with the following exceptions:
a. Offset to avoid perennial drainage.
b. Omit in congested area.

11. Spliced Edges
Drainage, roads, trails, various boundary lines, land grid, fences, and lakes will be altered to form continuous lines at splice edges. This will show on the Transfer Sheet, but will be corrected only on the Base Map.-*

*-25.2 - Coloring Completed Map. A more vivid picture of range suitability and condition can be obtained by coloring the allotment maps.

1. Condition will be shown in solid colors as follows: Excellent (dark green), Good (light green), Fair (orange), Poor (yellow), and Very Poor (red). Vegetation types without condition ratings (uncolored).

2. Suitability may be indicated by hachures and crosshachures on condition maps which are colored (providing hachures will not impair map readibility), or it may be indicated on a separate colored map. Colors to show suitability are: Primary Range (uncolored), Unsuitable Used (red), Secondary Range (light blue), Unsuitable Not Used (yellow), Suitable Closed (orange), Vegetation Types 7 and 8 (purple), and Transitory (green).

3. A colored vegetation type map for the allotment ordinarily will not be prepared. If it is needed, it can be prepared by using the vegetation type symbols on the map. The standard colors for these types are:

		Dixon's Color
1 - Grassland	Yellow	353
2w - Wet Meadows	Orange	324
2d - Dry Meadows	Orange	324
3 - Perennial Forbs	Lake red	321-1/2
4 - Sagebrush	Brown	343
5 - Browse-shrub	Olive green	325
6 - Coniferous Timber	Light green	354-1/2
7T - Heavy Timber	Blue green	320-1/2
7 - Other	Blue green	320-1/2
8 - Barren	Uncolored	-
9 - Pinyon-Juniper	Verdant green	325-1/2
10 - Broadleaf Trees	Pink	322
20 - Cultural Treatment Area	Red	349
- Water Surface	Sky blue	320-*

RANGE ENVIRONMENTAL ANALYSIS HANDBOOK

*-26- STANDARD MAP SYMBOLS FOR RANGE ADMINISTRATION

Fence	
Water Trough	
Pond or Reservoir	Wings point down stream 
Pipeline	
Windmill	
Well	
Ditch	
Study Exclosure (1 acre>)	
Corral	
Cattle Guard	
Stock Bridge	
Stock Driveway (brown)	

Benchmark — Location and Number	
Permanent Trend Transect	
Permanent Camera Point	
Study Exclosure (< 1 acre)	

Dirt Road	
Primitive Road	

*-Trail	
Alienated Land	
Forest Service Guard Station	
House, Cabin, or Other Building	
Helispot	
Recreation Site	
Rimrock	
Bluffs, Ridge, and Buttes	
Section Corner, Recovered	
Spring	
Permanent Stream	
Intermittent Stream	

CHAPTER 30
SUITABILITY, CONDITION, AND APPARENT TREND

Contents

CHAPTER 30
SUITABILITY, CONDITION, AND APPARENT TREND

Suitability, condition, and apparent trend are basic determinations in the range analysis job. Because of the many elements that go into their determination, it is necessary that a rather detailed treatment be made of each. It is for this reason that an entire chapter is devoted to their discussion.

31 — RANGE SUITABILITY. Range suitability is the most critical and the most difficult of all determinations made in range analysis. Grazing capacity is hinged to a large extent on its determination. A good knowledge of the elements that go into its determination is therefore of greatest importance.

31.1 — Basic Principles Governing Range Suitability. Much of the area of Region 4 is used as pasturage by domestic livestock. These lands post many management problems because of their differences in elevation, topography, vegetation types, and character of soils. They extend from deserts, where the vegetation is sparse and brushy in character, to the lush subalpine-herb lands and in some instances to the harsh alpine. In between is a great variety of range sites and conditions. Each of these areas has its own limitations. Failure to recognize natural limitations of the land has resulted in costly mistakes in land use, which, in the past, have caused serious damage to the soils of range-watersheds.

The Forest Service, in analyzing rangelands, uses the term "suitability" to define land adaptable to livestock use. Suitable range means forage-producing land which can be grazed on a sustained-yield basis under an attainable management system without damage to the basic soil resource of the area itself or of adjacent areas. This term is often confused with the common term "usable" range, which is different in meaning from the term "suitable." Many areas can be grazed by livestock and are therefore usable, but they cannot be grazed year after year without damage to the soil resource. [redacted] ranges that can be grazed by livestock can be called usable, but may not be suitable because of the resulting damage to the sites. Ranges are suitable only if they can be grazed on a sustained-yield basis without damage to the basic soil resource.

The suitability of range for grazing is determined by two major factors. First, the physical characteristics of the terrain which includes steepness and length of slope, natural barriers, amount and distribution of water, and other factors that would prevent free access to the grazing animals under attainable management; second, the inherent characteristics of the soil and vegetation.

The natural physical limitations can be modified to a degree by management. Pasture management is an aid to more effective distribution of cattle. Rotation grazing allows for periodic grazing followed by rest. Heavy pasture stocking for short periods of time tends to force cattle onto areas which may not be used under open range grazing conditions. Providing additional water can greatly expand the primary range in certain areas. Season of use can have a strong influence on livestock distribution.

1. Physical Characteristics of Terrain.

a. *Steepness and length of slope.* Slope is one of the most important factors that limits livestock use on mountainous rangelands. This is particularly true with

cattle grazing. Cattle by preference will excessively graze the gentle topography close to water before they will move onto the slopes. Consequently, these preferred areas are generally overgrazed and may be severely damaged in the effort to force cattle onto the slopes. The soils in such areas are generally the deepest and most productive. Under excessive use these areas produce far less than their forage production potential.

Studies on the use of slopes by cattle are being made in various locations by the Utah State University, the Intermountain Forest and Range Experiment Station, and others at the present time.

Results obtained from use checks on a study area on the Stansbury Mountains near Grantsville, Utah, showed that most of the range classed as suitable was on slopes of 5 to 18 percent. Even though this range was in poor condition and far below its potential production, it still supported 80 percent of the cattle use in that area. Use intensity on slopes below 12 percent showed 12 to 15 cow days per acre, while immediately adjacent to these areas on slopes over 20 percent use intensity dropped to 3 cow days per acre.

Sheep use is also affected by slope but somewhat differently than cattle use. Sheep show preference for the upper slopes and high basins rather than lower slopes and canyon bottoms. There are some advantages to handling sheep on moderately steep slopes in that they do not travel as far or as fast and have a tendency to settle down and feed better (5). Soil stability limits use on sheep ranges more than the topography. Much steeper slopes can be grazed where the soils have a high resistance to trampling and erosion. Conversely, where a soil lacks these qualities, slope becomes an important factor of suitability.

b. *Natural Barriers.* Natural barriers prevent or reduce free access of grazing animals. Included in this classfication are ledges, rockslides, bogs, down timber, and heavy brush. Some of these are permanent, but some can be modified to some extent by range improvements. Often trail construction and brush control can open up new range areas. The work done in these instances depends on the cost and the values received.

c. *Amount and Distribution of Water.* Well-distributed watering places are essential for good range management. Poor water distribution will cause excessive grazing use adjacent to the watering places and can lead to adverse effects on the livestock gains. For the best results on mountainous rangeland, cattle should not be forced to go over one-half mile to water (11, 12). Studies show that cattle should not be forced to travel over 2½ miles even on level terrain. On mountain rangelands sheep should not be expected to travel over one mile (5). When this distance is exceeded, herding becomes difficult and damages to the range mount rapidly.

2. Soil and Vegetation.

a. *Vegetal cover.* There is a big difference in the vegetal cover between the deserts and humid mountain slopes. On the deserts the plants are usually widely scattered. This results in a large amount of bare soil or exposed pavement if the soils are gravelly. On mountain slopes soil stability is dependent to a large degree on the adequacy of the vegetative cover.

Studies on the effect of vegetation on runoff of mountain range-watersheds were started in 1915 on the mountains above Ephraim, Utah (4). Since then numerous studies of ground cover requirements have been made at various locations in the western mountains.

During the past 15 years cover requirements have been studied on five watersheds in

the Intermountain and Northern Rocky Mountain areas. Two of these were conducted on the coarse granitic soils of central Idaho, one on the sandstone and shale soils of Montana, one on the fine textured limestone soils of central Utah, and one on the medium textured soils of the Davis County Watershed in Utah.

On all five studies, it was concluded that at least a 60 to 70 percent ground cover (vegetation plus litter) was necessary to protect mountain slopes from excessive runoff and erosion from moderately high intensity summer storms (9, 10, 7, 8, 6, 1, 2, 3).

The studies showed that if the ground cover is reduced below the critical cover percentage, accelerated runoff and erosion resulted (10).

These studies give rather strong indications of the minimum ground cover needed to maintain stability of mountain slopes. If this minimum ground cover is not maintained or restored, these mountain slopes will be under the continuous threat of overland runoff and erosion from high-intensity storms.

b. *Special Soil Characteristics.* Various characteristics of the soil such as texture and depth play important roles in determining the use intensity that a site can stand. Very shallow soils are a problem in range management because their low production capacity makes it difficult to maintain an adequate plant cover for their protection. Consequently, even light grazing use may upset the balance and result in soil damage.

Soil texture will also limit the grazing use that an area can stand. Coarse soils from sandstones and granitic parent rock are often so loose that livestock grazing over the slopes will cause them to slough downhill, which results in burying of plants and exposure of roots. Some plants are even pulled up or trampled out of the ground. It is almost impossible for seedlings to become established on such slopes under grazing use. Trampling damage on these coarse textured soils increases with the steepness of slope.

Extremely fine textured soils may be equally difficult to manage. Very fine textured soils are compacted by grazing use which in turn lowers the infiltration capacity and increases runoff. Some of the greatest extremes in soil gullying and erosion of our areas are found on these fine textured soils.

3. Application in Suitability Classification.

In range suitability classification a knowledge of the land capabilities is basic. The factors that place limits on use have been discussed. The following guides discuss the application of these factors.

a. Cattle should be allowed to graze on slopes only to the point where the more accessible lands are not damaged. Highly productive areas of the gentler terrain must not be sacrificed to force livestock onto the slopes.

b. If livestock are required to travel excessive distances to water, considerable areas of range adjacent to the water will be damaged. Therefore, areas beyond the safe grazing distance should not be considered as primary range.

c. If a management objective of a range is established for at least a two-thirds ground cover on mountain slopes, the classification of areas that have less than this amount of cover will depend on the extent of deterioration and the inherent resistance of the soil to erosion. Where the range deterioration has not been too great and the soils are not of a highly erosive nature, improved management will generally allow for complete restoration. However, on highly erosive soils complete protection plus artificial treatment may be the only means of restoration.

Exhibit 31.1

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31.2 — Classification of Range Suitability.

1. *Suitable Range.*

a. *Primary Range.* See Chapter 20, Section 23.2-1 for definition.

b. *Secondary Range.* Land suitable for grazing but which is not used because of deficiencies in management and improvement facilities. See Chapter 20, Section 23.2-1 for definition. Some examples of secondary range of Region 4 are:

(1) Areas remote from water. This would include areas that are beyond the point where forced grazing use is required and damage results to the bench marks. Even on the most favorable terrain cattle should not be required to travel over 2½ miles to water, on mountainous terrain this would be reduced to ½ mile. Sheep should not be required to go more than one mile from water on mountain rangelands. Careful checks of well-selected bench marks will give further guidance to the range manager.

(2) Large aspen patches on cattle range where favorable open areas are intermixed. In such instances the cattle will not graze the aspen until the openings are excessively grazed.

(3) Areas some distance from the main body of suitable range or patches of range surrounded by unsuitable range. Often a benchland above highly suitable canyon bottoms must be classed as secondary until some system of management is devised to allow its use without damage to the highly suitable bottom lands.

(4) Areas infested with poisonous plants. Improved management and range improvements may allow full use of this type of secondary range. When this is done the classification will be changed to primary range.

2. *Unsuitable Range.* Unsuitable range includes nonforage producing lands and forage-producing lands which cannot or should not be grazed because:

a. Physical characteristics of the terrain either exclude grazing or require excessive use of the suitable areas in order to force use onto the unsuitable areas. These physical characteristics include such features as steepness and length of slope, natural barriers, rocks, and areas where there is no practical possibility for developing water.

b. Limits set by soil and vegetation. Some of the common situations in Region 4 where range would be classed as unsuitable because of soil and vegetation limitations are:

(1) Loose granitic soil on steep slopes.

(2) Highly erosive soils from shale and mudstone.

(3) Areas of insufficient vegetal cover to protect the soil from erosion where restoration would not be possible or practical under continued grazing use.

c. In Region 4 unsuitable range is also classified as to whether it is used. The percentage of unsuitable range used is an important guide to the stocking intensity.

An occasional cow may be found on the most difficult terrain, but such negligible use will not be a cause to classify range as "Unsuitable Used." Any use under one cow day per acre will be considered negligible and such range will be classified as "Unsuitable Not Used."

31.3 — Standards and Guides for Suitability Classification. Each Forest will develop suitability criteria as needed. In line with instructions in FSM 2212.33, the following elements will be considered in developing suitability criteria:

1. *Forage Productivity.* Areas with excessively low inherent abilities to produce forage will be classified as unsuitable. Areas producing less than 50 pounds of forage per acre dry weight are considered to be unsuitable. Understory of lodgepole pine type may have high herbage production represented by such plants as low huckleberry, which has low forage production. The forage production in this type is generally under 50 pounds per acre dry weight. However, potentially productive rangelands in depleted condition should not be classified as unsuitable because of low forage production.

2. *Soil Stability.* Soil stability or the ability of soils to resist erosion is determined by a number of factors; the major ones are climate, soil erodibility, topography, and ground cover. Climate has to do primarily with storm frequency, intensity, and duration. Soil erodibility relates to those inherent physical characterstics of the soil that determine its stability or instability. Topography relates to length and steepness of slope. Ground cover consists of live plants, litter, and certain rock fragments. A combination of all these factors provides the basis for the determination of the erosion hazard (FSM 2512.5). The only factor that man may control is ground cover. However, all these factors should be considered in range management planning, but soil erodibility, topography, and ground cover will have a special significance in range analysis. They are considered in rating both condition and suitability. The following factors affecting soil stability are important in suitability guides:

a. *Soil Erodibility.* Soil erodibility is a term applied to the inherent erodibility of the soil without consideration of climate, topography, and ground cover. See Exhibit 41.26-C, Chapter 40, for determination and classification of soil erodibility. Soil erodibility is rated in five classes (I to V). Classes I to III which represent low to medium soil erodibility and classes IV to V which are moderately high to high. Much more management latitude is possible in the first three classes than would be possible in the last two. In determining suitability, these differences have to be taken into consideration.

b. *Topography.* This includes slope gradient, length of slope, roughness of slope, and shape of land forms as they affect soil stability.

c. *Amount of Ground Cover.* Ground cover may be a critical guide to suitability. Where ground cover is less than the minimum required for soil stability, careful consideration will be necessary to determine if the area is suitable for grazing use. If cover can be restored under a reasonable system of management, the area can be classed as suitable. If this is not possible, the area must be considered as unsuitable.

d. *Dispersion of Ground Cover.* A high degree of dispersion may be important as large amounts of ground cover for effective soil protection. This is especially applicable to mountainous areas of relatively high production potential. Sites with uniform dispersion and low ground cover may have greater stability than areas with higher ground

cover but with variable dispersion. Both the amount of ground cover and dispersion of ground cover should be considered in classifying suitability.

3. *Current Erosion.* Current erosion is an indicator of unstable site condition. It is characterized by observable indicators of soil movement. All of the factors governing soil stability are more or less reflected in the time and rate of erosion. The efforts required to restore soil stability depend on how far deterioration has progressed and the inherent erodibility of the soil. If the erosion on an area can be arrested and stability restored under an attainable management system, the area should be classed as suitable. If this is not possible, the area will be classified as unsuitable.

4. *Physical Barriers.* This includes brush, down timber, surface stones or other obstructions that would prohibit or arrest free access by livestock and would cause the range to be unsuitable.

5. *Slope.* Slope should be considered as a physical factor in suitability determination as it affects the free movement of grazing animals under reasonably attainable levels of management. Slope is the most critical factor in suitability determination, particularly on cattle ranges. Frequently, the degree of slope cannot be used by itself as a clear-cut guide to suitability but must be considered as it interacts with other local factors. Among these are location of water, length of slope, and kind of livestock — even their familiarity with the range. These and any other local factors which may be pertinent should be considered in defining reasonable guides for slope in suitability determination.

6. *Distance from Water.* Distance from water is one of the strongest controlling factors of livestock use and distribution. It is also the one factor that has the greatest possibility for change. This factor may be particularly important in classifying secondary range.

R-4 RANGE ANALYSIS HANDBOOK

Exhibit 31.3-A
SAMPLE
Range Suitability Criteria For Sheep Range

1. Natural forage production less than 50 lbs. per acre dry weight type as 7 or 8

1. Natural forage production exceeds 50 lbs. per acre dry weight

2. Area inaccessible to sheep grazing under reasonable herding effort including availability to water ..... N or (S)

2. Area fully accessible

3. Erodibility Index I-III

4. Slopes exceeding 65 percent ..... U or N

4. Slopes 46-65 percent

5. Ground cover 60 percent or less ..... U or N

5. Ground cover 60 percent and over

6. Current erosion advanced or severe ..... U

6. Current erosion none to moderate ..... S

4. Slopes 26-45 percent

7. Ground cover 50 percent or less ..... U

7. Ground cover 50 percent or more

8. Dispersion of ground cover variable or highly variable .... U

8. Dispersion of ground cover fairly uniform or uniform

9. Current erosion advanced or severe ..... U

9. Current erosion none to moderate ..... S

4. Slopes 0-25 percent

10. Ground cover 40 percent or less ..... U

10. Ground cover over 40 percent

11. Current erosion advanced or severe ..... U

11. Current erosion moderate or none ..... S

3. Erodibility Index IV-V

12. Slopes 45 percent or over ..... U

12. Slopes under 45 percent

13. Ground cover 60 precent or less ..... U

13. Ground cover over 60 percent

14. Erosion moderate or greater ..... U

14. Erosion light to none ..... S

R-4 RANGE ANALYSIS HANDBOOK

Exhibit 31.3-B

SAMPLE

Range Suitability Criteria For Cattle Range

1. Natural forage production less than 50 lbs. dry weight
   2. Natural barren of rock areas ..... Barren
   2. Natural timber or other nonrange sites 7
1. Natural forage production over 50 lbs. dry weight
   3. Not accessible to cattle under practical livestock management ..... N
   3. Accessible to cattle
      4. Erodibility Index I, II, and III
         5. Slopes 30 percent or over ..... U or N
         5. Slopes 20 to 30 percent
            6. Ground cover less than 60 percent ..... N or U
            6. Ground cover over 60 percent
               7. Current erosion moderate to very heavy ..... U or N
               7. Current erosion light to none
                  8. Distance from water over ½ mile
                     9. Low potential range ..... N or U
                     9. Moderate to high potential range ..... (S)
                  10. Distance from water less than ½ mile ..... S or N
         5. Slopes under 20 percent
            11. Distance from water over 1 mile ..... (S) or U
            11. Distance from water less than 1 mile
               12. Erosion rate moderate or worse ..... U
               12. Erosion rate light or none ..... S
      4. Erodibility Index IV to V
         13. Slopes over 20 percent ..... N or U
         13. Slopes under 20 percent
            14. Distance from water over 1 mile ..... U or (S)
            14. Distance from water under 1 mile
               15. Erosion rate moderate or more ..... U
               15. Erosion light to none ..... S

32 — RANGE CONDITION. Range condition is range health. Condition is judged by an ecological standard or ideal for each range type. Both the soil and vegetation will be considered in determining range condition. Each will be rated separately with the lowest rating used to assign condition classification to the type. The terms excellent, good, fair, poor, and very poor describe the various degrees of range condition.

32.1 — Condition Based on Vegetation. Condition of vegetation will be based on species composition and relation of present production to the potential of the site. In Region 4, production in relation to site potential is used as a representation of vegetal cover and vigor.

1. *Vegetal Composition.* Vegetal composition is the proportion by weight of the various species of plants within the type or plant community. For proper interpretation of the effects of grazing on vegetation, species are classified into three groups according to their response to grazing. The three groups are Desirables, Intermediates, and Least Desirables. The composition rating is judged on the degree of departure from the pristine site. Vegetal composition rating is based on the "Guide for Rating Vegetal Condition." (See Chapter 40, Exhibit 41.28-A.) Species will be classed as Desirables, Intermediates, and Least Desirables, based on the "Species Lists." (See Chapter 40, Exhibits 41.21-C and 41.21-D.)

a. *Desirables.* These are species and percentage occurrence of the species common to pristine plant communities. They are usually good forage plants and are first to show adverse effects of excessive grazing use. The species are generally good soil binders, especially in natural mixtures. Areas in pristine condition are characterized by a well-balanced mixture of desirable species.

b. *Intermediates.* These are also species of the pristine plant community, but which are not as adversely affected by grazing use as are the "Desirables." They may be less palatable to grazing animals or be more resistant to grazing use. As a result they either hold their own in the stand or they may increase in proportion to other species or even replace the most desirable species that are lost or reduced as a result of selective grazing use.

c. *Least Desirables.* These are the poorer species in a type or community. They may consist of ruderals, invaders, and species that persist in dominant proportions after a long period of continuous heavy grazing use. The plants in this group as a rule have poor soil binding qualities and as a consequence heavy soil erosion may result from their presence.

2. *Production in Relation to Site Potential.* Present production as it relates to the potential of the site will be used to represent vegetal cover and vigor. Site potential will be based on the character and depth of the soil. Site potential will be discussed in each General Condition Standard, Section 34.

32.2 — Condition Based on Soil. Condition based on soil is the second phase of condition classification. Soil condition will be determined by the amount and dispersion of ground cover and the current erosion. All of these factors are a reflection of range health.

1. *Ground Cover.* The basal area of plants plus litter will generally constitute ground cover. Exceptions are mat-forming plants such as *Antennaris*, *Phlox*, *Silene*, moss and lichens, in which case the entire plant will be counted as ground cover.

Rock and pavement larger than 3/4 inch in diameter will also be counted as ground cover and its percentage will be added to that of vegetation and litter

~~Rock and pavement that occur naturally and are not a result of soil instability will also be counted as ground cover and their percentage will be added to the~~ vegetational ground cover. Unnatural rock and pavement will be considered as bare ground.

2. *Plant Dispersion.* Well-dispersed vegetation is much more effective in protecting soil than clumpy vegetation. This is borne out by studies and observations. To compensate for poor dispersal, the ground cover index will be lowered five points for each dispersal rating below the one indicated for each class in the guide. (See Chapter 40, Exhibit 41.28-B and 41.28-C.)

3. *Current Soil Erosion.* Current soil erosion is given equal weight with the amount and character of plant cover in classifying the soil phase of range condition. The amount and character of erosion is the final indicator of soil stability or lack of stability. It also acts as an equalizer in the soil stability classification. For example, a 40 percent ground cover on a 50 percent slope may result in advanced erosion. The same amount of ground cover on a 10 percent slope may result in only slight erosion. The difference would be reflected in the soil condition classification in that the steep slope would be rated in poor condition while the 10 percent slope would be rated fair. See Chapter 40, Exhibits 41.28-B and 41.28-C for studies for rating soil condition.

33 — GENERAL INDICATORS OF APPARENT TREND IN RANGE CONDITION. Indicators of apparent trend have been divided into two groups, one indicating downward trend and the other indicating upward trend. The indicators are further classified into indicators of soil trend and indicators of trend in vegetation. It is not safe to base conclusions with reference to trend on one or two indicators unless they are especially strong. If a majority of indicators point to improvement, the trend should be judged as being upward; if a majority point to deterioration, the trend should be judged as being downward.

33.1 — Soil Indicators of Downward Trend.

1. *Rill Marks.* Rill marks are small active gullies, frequently of the shoestring type. They often appear during storms but may be obliterated later, depending on depth of cutting.

2. *Active Gullies.* These are established gullies that are raw and actively cutting. This type of gully may vary from a few inches to several feet in depth.

3. *Alluvial Deposits.* These are soil material transported and laid down by running water. Soil deposits may be found in depressions, behind piles of litter or debris, or at the termination of rills and gullies. Recent deposits may partially cover the basal portions of established plants. They may be distinguished from old ones by the absence of perennial vegetation on the deposit.

4. *Soil Remnants.* Soil remnants are portions of the original topsoil held in place by vegetation or plant roots. They may form the base of pedestalled plants. Soil pedestals carved by rocks or pebbles are usually of recent origin following storms. Steep-sided soil remnants indicate soil instability and a downward trend. Almost vertical sides are characteristic, often with exposed roots of the plants holding remnants of the soil.

5. *Active Terraces.* Active terraces are "stairstep-like" in appearance on slopes.

They are produced by an accumulation of soil above clumps of vegetation and by the removal of soil from the clumps below. Terraces are usually caused by the hooves of animals. Active terraces have steep sides, show evidence of sliding soil, exposed live roots, and are not stabilized by vegetation.

6. *Exposed Plant Crowns or Roots.* This is soil loss taking place currently as shown by exposed crowns or roots appearing on young, deep-rooted perennial plants.

7. *Wind-Scoured Depressions Between Plants.* Wind removal of soil particles causes depressions in the surface of the soil. In extreme cases the soil surface is merely a series of shallow depressions separated by low ridges of vegetation. If the surface of the depression is scoured or etched, rapid downward trend is indicated.

8. *Wind Deposits.* Wind deposits are formed by fine soil particles that have drifted onto the lee side of vegetation or into the vegetation itself. Recent wind deposits show little, if any, discoloration of the surface material by organic matter and no decomposition of buried plant parts.

33.2 — Soil Indicators of Upward Trend.

1. *Gullies Healed.* These are gullies which originate on the area and are stabilized by the growth of perennial vegetation on both sides and bottom. The sidewalls will be rounded in appearance. The presence of vegetation in gully bottoms is not in itself a reliable indicator of improved range condition. It may be highly misleading if used without a careful appraisal of conditions on the area drained.

2. *Sloping-sided Soil Remnants.* These are soil remnants with sloping sides, or sides clothed with mosses, lichens, or higher plants. Plant roots are covered by soil. Space between soil remnants are being occupied by perennial plants.

3. *Healed Terraces.* Stabilized terraces are characterized by sloping sides clothed with vegetation and no exposed live roots. Tops of terraces are invaded and occupied by perennial plants.

33.3 — Plant Indicators of Downward Trend.

1. *Better Forage Plants Unavailable to Livestock.* Better forage plants may be largely confined to the protection of shrubs. Openings between shrubs may be largely occupied by unpalatable plants of various age classes.

2. *Hedged and Highlined Shrubs.* Dead and dying hedged plants present. Dead branches generally indicate that shrub is dying.

3. *Lack of Reproduction and Young Plants of Better Species.* Absence of seedlings or young plants of both palatable and unpalatable plant species may indicate that the microclimate is unfavorable for germination or seedling survival. If seedlings and young age classes of unpalatable plants are present and those of palatable plants are absent, it may be assumed that grazing is too severe for palatable plants to become established. Downward trend is indicated.

4. *Invasion by Unpalatable Plants.* Invasion by unpalatable or poor forage plants is an indicator of downward trend in forage value.

5. *Palatable Plants Lacking in Vigor.* Low vigor in plants is shown by the pale, sickly color of foliage, few seed stalks produced by grasses, shallow or scant root systems of normally deep-rooted plants, and absence of seedlings.

6. *Scarcity of Litter of Palatable Plants.* Litter scarce and poorly dispersed.

33.4 — Plant Indicators of Upward Trend.

1. *Better Forage Plants Invading and Readily Available to Livestock.* Better forage plants growing in the openings between shrubs.

2. *Invasion of Bare Spots by Better Forage Plants.* Invasion must be positive, that is, a variety of age classes must be represented in addition to seedling reproduction. Better forage plants should be invading in stands of unpalatable plants or on bare ground lacking vegetation. Invasion by perennials into openings between shrubs is a good indicator of upward trend.

3. *Invasion on Erosion Pavement.* Invasion and establishment of perennial plants on erosion pavement is a good indication of upward trend. The basal parts of invading plants will be flush with the ground surface if soil erosion has stopped.

4. *Several Years' Growth from Hedged Browse.* At least two or more years' regrowth is evidence of upward trend in forage condition. The age of regrowth is readily established by a count of annual growth rings.

5. *Palatable Plants Vigorous.* Grasses robust with many leaves, seed stalks tall and numerous, leaves a healthy green color. Forage plants reproducing vigorously with a variety of age classes present.

6. *A Well-Dispersed Accumulation of Litter from Past Years' Growth.* Generally a well dispersed layer of litter accompanies a well-dispersed vegetal cover.

For more detailed description of indicators of range trend refer to Agriculture Handbook No. 19 "Indicators of Condition and Trend on High Range Watersheds of the Intermountain Region" by Ellison and Croft.

34 — GENERAL CONDITION STANDARDS

34.1 — Condition Standards for Big Sagebrush. (To be written.)

* **34.2 — Condition Standards for Aspen Ranges.** ~~(To be written.)~~ R-4 Amendment #

34.3 — Condition Standards for Alpine Ranges. ~~(To be written.)~~ deleted

34.4 — Condition Standards for Tall Forb Ranges. ~~(To be written.)~~ deleted

* Deleted by R-4 Supplement #6 of 5/70

See R-4 Amendment #5 dtd. Apr. 197

Posted 4 May 70 CAO

RANGE ENVIRONMENTAL ANALYSIS HANDBOOK

34.2 - Condition Standards for Aspen Ranges. Aspen, as a type, has a wide range of values and uses in the Intermountain Region. The tree is becoming increasingly valuable as a timber species. Understory vegetation and aspen sprouts are important sources of forage for livestock and big game. These uses, plus the watershed and esthetic values of the species, establish the aspen type as one of the most valuable vegetation communities of the Region.

In Utah and along the Idaho-Wyoming line, where aspen reaches its greatest development in the Intermountain Region, there are definite zonal relationships with other major plant communities. Generally, the aspen type occupies the mountain slopes between the mountain brush and the spruce-fir zones at elevations between 3,000 and 11,000 feet. This zone is characterized as the aspen-fir zone because white fir and Douglas-fir are important components of the vegetation on many sites (Sampson 1919).

The aspen tree is short-lived, generally forms even-age stands because it does not reproduce in its own shade, and reproduces mainly from roots and suckers. Aspen has been found forming definite clonal variation within the species (Baker 1925) and (Cottam 1954). Due to asexual reproduction, aspen may be able to occupy a wider range of environmental conditions because, once it becomes established, it does not have to rely on seed and seedling establishment for further expansion (Langenheim 1962).

In developing the following "Condition Standards," the aspen community is considered only as a range type, and timber aspects are used only incidentally. Therefore, only factors that affect it as a range type are considered. These factors would include soils, condition of understory, site potential for forage production, and management geared to optimum production of forage and maintenance of a healthy aspen stand.

1. Soils. Aspen occurs on a wide variety of soils, even though the dark-colored surface soils may appear rather uniform. The landforms upon which aspen has developed include colluvial slopes, alluvial terraces, mountainside slopes, glacial moraines, drainageways, old landslides, and slumps. Parent rock materials and/or the underlying strata include many sedimentary, metamorphic, and igneous rocks. Soil profiles exhibiting buried horizons are not uncommon, and many of the surface soils have characteristics resembling loess. Bedrock formations generally do not occur within six feet of the surface.

The surface soil horizons are typically medium textured, have granular structure, are soft, and contain a relatively high content of organic matter. Well-developed, light-colored, bleached subsurface horizons are present in some of the soils. Subsoils are commonly more clayey than the surface soils, but range from sands to clays. The profiles may be gravelly, cobbly, or stony. Surface horizons are generally slightly acid, but subsoils vary from strongly acid to alkaline.

Most of the soils are well or moderately well drained, but many of those that have developed on slumped materials or in drainageways have excessively wet subsoils for significant periods each year. This imperfect drainage may be caused either by soil horizons with low permeability or by high water table.

2. Composition of Understory. Understory vegetation in aspen consists of a large assemblage of tall, lush species. In a study of conditions for aspen ranges of Utah, Nevada, Southern Idaho, and western Wyoming, about 300 species were found occurring in limitless combinations within the aspen type (Houston 1954). From site studies in the Intermountain Region, 67 important species have been recorded in aspen understory.

Sites analyzed through central Utah and western Wyoming, the area of highest aspen development, give a rather characteristic species pattern. However, peripheral areas such as the east end of the Uinta Mountains, Paunsaugunt Plateau, and various places in central Idaho take on an ecotonal characteristic of adjacent vegetation types.

In the Intermountain area, aspen understory is broken into three groups; namely, permanent aspen, transition aspen, and those of ecotonal or periphery positions. Major emphasis will be given to the first group.

a. Permanent Aspen or Climax. The permanent aspen type is characterized by the species itself, Populus tremuloides. The underassemblage of herbaceous and shrubby species is characteristic, yet no individual species consistently occupies a dominant role on sites judged to be in good or excellent condition. Fifteen different species were dominant in the 32 sites studied. Exhibit 34.2-1 lists the most common species found on the aspen understory. They are ranked by frequency of occurrence and by composition percentage. The range condition was classed as good on most sites. As a group, forbs consistently dominate the understory. The summary of the site studies shows forbs, 62 percent; grasses, 2 percent; and shrubs, 17 percent.

b. Transition or Disclimax Aspen. The tree overstory may consist of a pure aspen stand or a mixture with conifers. The understory vegetation of the aspen-conifer community tends to take on the character of that found in the conifer community. This is especially true where the dominant tree has been changed recently. However, as the aspen community ages, there is a tendency for it to develop an understory vegetation typical of the permanent aspen type.

Insufficient site studies prevent concrete characterization of the transition aspen community. However, certain tendencies were observed. First, there was a higher percentage of shrubs on sites where the soils showed some A_2 development. Second, production is generally, but not always, lower. Common understory species in this community are Aster engelmannii, Epilobium angustifolium, Lupinus spp., Pachistima myrsinitis and Prunus virginiana, in addition to many species common to the permanent aspen community.

RANGE ENVIRONMENTAL ANALYSIS HANDBOOK

Exhibit 34.2 - 1

Frequency by Species and Average Percent Composition by Weight per Macroplot from Plots on 32 Aspen Sites. Only species with at least 25% frequency are included.

Species	1/ Percent Frequency	Average Percent of Composition	Tendency Towards Dominance
Symphoricarpos spp.	84	11.5	Strong
Bromus marginatus	84	6.4	Medium
Vicia americana	75	5.3	Medium
Lathyrus leucanthus	72	13.6	Strong
Thalictrum fendleri	72	8.7	Medium
Viola spp.	69	1.2	Weak
Elymus glaucus	59	8.0	Medium
Agropyron trachycaulum	56	3.6	Weak
Stellaria jamesiana	56	2.7	Weak
Poa reflexa	56	2.3	Weak
Osmorhiza occidentalis	53	4.5	Weak
Taraxacum officinale	53	0.6	Weak
Rudbeckia occidentalis	50	7.6	Medium
Hackelia spp.	50	3.3	Weak
Geranium spp.	47	3.3	Medium
Achillea lanulosa	41	4.8	Medium
Galium boreale	41	1.8	Medium
Agastache urticifolia	38	4.0	Medium
Melica bulbosa	38	0.7	Medium
Senecio serra	34	14.2	Strong
Agropyron subsecundum	34	4.4	Weak
Valeriana occidentalis	34	3.5	Weak
Rosa spp.	34	2.4	Weak
Aster engelmannii	28	6.2	Medium
Amelanchier alnifolia	28	2.6	Weak
Smilacina spp.	28	2.1	Weak
Osmorhiza chilensis	28	1.2	Weak
Delphinium spp. (tall)	25	14.4	Strong
Mertensia spp.	25	11.2	Strong
Stipa columbiana	25	2.5	Weak
Aster spp. (other)	25	1.5	Weak
Berberis repens	25	1.2	Weak

1/ Based on occurrence on 100' x 50' macroplots.

c. Ecotonal Aspen. In peripheral areas of the main body of aspen as it extends from southeastern Idaho and western Wyoming through central Utah, the typical understory vegetation of the aspen community takes on many of the characteristics of the adjacent plant communities. In certain areas where aspen appears to be invading adjacent communities, the more shade tolerant species form the understory vegetation of the aspen type. For example, in the LaSal Mountains where aspen is invading the Festuca thurberi community, there is a gradual change in understory vegetation from the edge to the center of the aspen stand. On the outer edge, Festuca thurberi and most of its associates are found. As the center of the stand is approached, shade tolerant species such as Carex geyeri dominate.

On the Paunsagunt Plateau, Muhlenbergia montana and other open grassland plants make up the aspen understory. In aspen stands on the east end of the Uinta Mountains, species from the sage-grass type are found in the understory. These peripheral areas of the aspen zone have not been studied sufficiently to be fully characterized.

3. Site Potential for Herbage Production. Estimates of herbage yield potentials will be guided by the general relationships shown in Exhibit 34.2 - 2 until more soils are classified and recognized. The yield estimates should be modified wherever local conditions or field experience indicates that adjustments are in order.

Results from preliminary studies indicate that a relationship exists between herbage yield (in good or excellent condition) and certain soil properties. These properties are (1) degree of internal soil drainage, (2) thickness of the dark-colored surface horizons, (3) subsoil texture, and (4) subsoil pH. The first three of these directly affect the capacity of a soil to retain moisture for plant growth. The thickness of the dark-colored surface horizons may additionally be an index of nutrient levels. Subsoil reaction might be related to either nutrient uptake or to differences in tolerances of the native plant species.

a. Soil Drainage. Imperfectly drained soils are wet for significant periods during the growing season, especially in the subsoils. Field evidences of imperfect drainage are the presence of a water table or seepage within about 60 inches of the surface or color mottling in the subsoil. Color mottles (splotches) are usually bright and include the red and yellow hues.

b. Thickness of the Surface Soil. Most of the surface soils of the aspen exhibit similar characteristics. Common textures are loams or silt loams, the structure is granular, organic matter content is relative high, and they are slightly acid. Invariably, the surface horizons have qualities that are highly favorable for the production of herbage. The most significant variable regarding the surface soil seems to be its thickness. The surface layer on the aspen sites is readily recognized by its dark color and, technically, it includes the A_1 and A_3 horizons (if the latter is present).

c. Subsoil Texture. The moisture holding capacity of the subsoil can be appraised indirectly from texture. Herbage yield differences have been related to three significant textural groups (1) fine (the clays and silty clays), (2) medium (the silty clay loams, clay loams, silt loams, loams, and sandy loams), and (3) coarse (the loamy sands and sands).

d. Subsoil Reaction. The pH of subsoil also appears to be significant in influencing herbage yields. As a group, the moderately acid, slightly acid, neutral, and slightly alkaline soils, are commonly associated with the higher yields, whereas lower yields are typically associated with the strongly acid (pH 5.5 or lower) soils.

No great differences in herbage yields in the aspen range type are believed due to climatic variations. Some differences may exist but, based on general observations over the past decade, they appear to be minor.

4. Indicators of Condition and Trend.

a. Plant Composition. It has been stated before in these standards that aspen understory consists of a large number of species, none of which show any marked degree of dominance. Under grazing use, and particularly where it has been excessive, there is a marked change in the species composition. There are several earmarks of condition deterioration. Composition may have a tendency to go towards species of lower desirability such as Rudbeckia and annuals, or it may go towards fewer species. Deteriorated range is often characterized by the dominance of one or two species or a predominance of grass or shrubs.

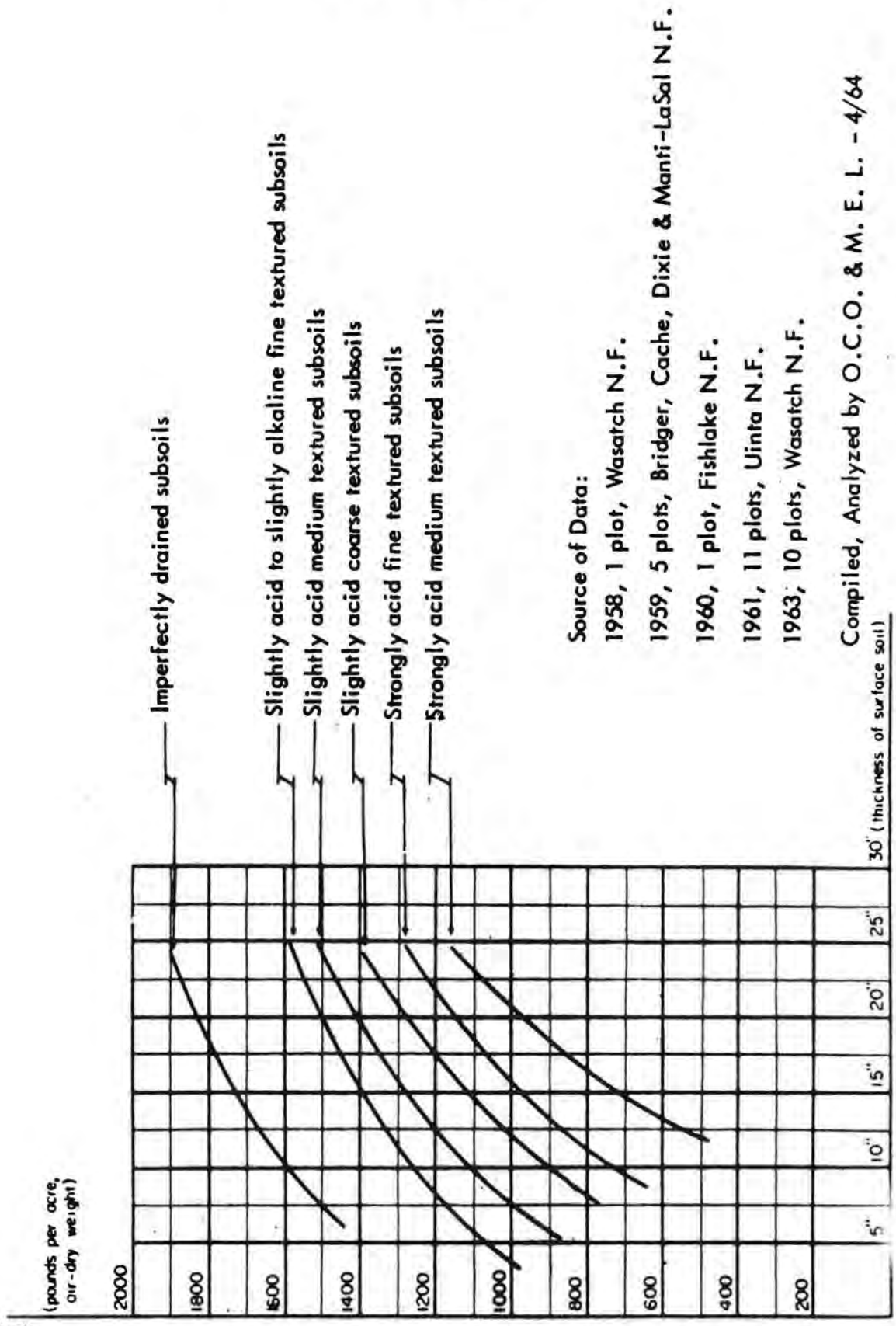
Species that tend to increase under grazing are Rudbeckia occidentalis, Senecio serra, Polemonium foliosissimum, Achillea lanulosa, Agropyron trachycaulum, Bromus marginatus, Elymus glaucus, and Mertensia. On many heavily grazed areas, Mertensia forms nearly pure stands. On ranges deteriorated in very poor condition, annuals such as Collomia linearis, Galium bifolium, Nemophila breviflora, and Madia glomerata may constitute the bulk of the understory.

The general species lists in Chapter 41.4 were developed and adjusted to fit field site studies which will reflect the proper percent of species in a composition rating. The "Guide for Rating Vegetal Condition" and "Composition Triangle" Exhibits 41-J and 41-J1, form the final basis for vegetation condition classification.

Condition may or may not be reflected in production. Ranges in poor or fair condition often produce more total herbage than those in good or excellent condition. However, species composition would be vastly different and the percentage of desirables would be lower.

RANGE ENVIRONMENTAL ANALYSIS HANDBOOK
Exhibit 34.2 - 2

TENTATIVE SOIL-HERBAGE YIELD POTENTIALS IN THE ASPEN RANGE TYPE
NATIONAL FOREST LANDS, INTERMOUNTAIN REGION
- - FIVE YEAR PROGRESS REPORT - -



Source of Data:
1958, 1 plot, Wasatch N.F.
1959, 5 plots, Bridger, Cache, Dixie & Manti-LaSal N.F.
1960, 1 plot, Fishlake N.F.
1961, 11 plots, Uinta N.F.
1963; 10 plots, Wasatch N.F.

Compiled, Analyzed by O.C.O. & M. E. L. - 4/64

5. Management to Maintain or Restore Desirable Condition of Aspen Ranges. Three objectives must be kept in mind in the management of aspen range; (1) maintenance of a healthy aspen stand which includes adequate provision for restocking after timber harvest, (2) management of the understory vegetation to maintain or restore an optimum production and variety of palatable forage for livestock and game, and (3) maintenance of productive capacity of the soil resource.

a. Management for Maintenance of Healthy Aspen Stand. "Guidelines for Coordination of Uses in Aspen Stands" makes provisions for coordinating range use with other uses. It states, "suitable areas for livestock grazing will be managed at proper stocking rates to maintain a satisfactory aspen cover, as determined by range analysis, except as indicated in other management guidelines." The principal effects of grazing on aspen are the prevention of aspen regeneration and the trampling of the soil within the aspen stand.

"Guidelines for Coordinated Uses in Aspen Areas," developed for the Region, includes some ground rules for restocking cutover aspen areas. Cattle will graze aspen shoots to a height of 55-60 inches; sheep, up to 42 inches. If the average annual aspen shoot growth increment is 15 inches, protection from sheep grazing would be required for three years, and from cattle grazing for four or five years to prevent serious damage to reproduction.

Heavy grazing use will suppress aspen reproduction, yet moderate use may be beneficial in controlling a part of the sucker growth. However, where other browse plants are scarce, particularly on predominantly grass range, all foraging animals may make destructive use of aspen reproduction, even with light grazing use.

Graham(1963), in discussing deer use in the Lake States, says "Aspen recovers almost immediately from browsing without bad effects." He further states, "When a sucker is nipped off, the first bud below the break almost always sends up a single shoot to take the lead." Such browsing may result in some increase in lateral branching.

Regardless of what requirements are necessary, it is to the interest of the range manager as well as to the timber manager to restock the stand. Grazing use should be so administered that no permanent damage is inflicted on the stand. Aspen ranges in deteriorated condition usually still have their soil cover and are much easier, than most ranges, to restore to high forage production and good condition.

Trampling damage by livestock to aspen stands is not too clearly understood. It is known, however, that an aspen stand dies out and is not replaced on areas where livestock concentrate. It is felt that rotational grazing, under moderate intensity, will minimize trampling damage.

b. Management of Understory Vegetation. The key to proper use of aspen range is generally tied to the condition of vegetation in the aspen openings because livestock prefer these areas. However, where aspen is found in small clumps in a broad expanse of grass, moderate use of the surrounding types may result in excessive use of the understory vegetation and the aspen trees.

In planning proper grazing, the situation on the most critical sites must be given precedent in judging rates of proper use. In other words, the areas that are damaged first must be used as the criteria for judging proper use of the entire unit.

The rate of use will depend, to a large extent, upon the grazing system used. Under either a rotation grazing or season-long grazing system, utilization of the key species should not exceed 50 percent. This rate should be reduced on ranges in the fair and poor condition classes.

Where rest-rotation grazing is practiced, heavier use can be allowed if a satisfactory vegetation-soil complex can be maintained on ranges in good to excellent condition, or where an upward trend can be obtained on ranges in fair to poor condition.

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34.3 - * * * * *

34.4 - Condition Standards for Tall Forb Ranges. (To be written.)

CHAPTER 40
*-SITE AND OCULAR ANALYSIS

CONTENTS

CHAPTER 40

SITE AND OCULAR ANALYSIS

*-Site analysis and ocular analysis writeups are used as a basis for condition classification and as a check on suitability. Writeups will be made of all suitable types. In addition, types that appear to be unsuitable will be analyzed where it is necessary to correlate livestock and other resource uses or where condition determination is basic in determining suitability. At least one out of five classifications must be supported by a site analysis transect (form R4-2200-13). The remainder can be sampled ocularly (form R4-2200-10). Where the technician feels that a larger percentage of weight estimates is needed, he may increase the number of site analysis transects. However, he should not increase the proportion of ocular analysis.

Each writeup (both site and ocular) will be identified in its proper type classification on the aerial photograph by entering in red ink the writeup number from form R4-2200-13 or R4-2200-10. Location of all site analysis transects will also be plotted in red ink on the photographs. Writeup numbers will identify the examiner by the first letter of his last name followed by the transect number; examples, J-1, J-2. Start a new set of numbers for each allotment.

Each site analysis and ocular analysis writeup will be supported by a documentation of the indicators used to determine the apparent trend of vegetation and soil for the type. Form R4-2200-25 may be used for this purpose. (See Exhibit 41-M.)

41 - SITE ANALYSIS

Site analysis is a plot-by-plot check of vegetation and cover on an area based on a combination of measurements and estimates. At the beginning of this phase of the work, the examiner should "set his sights" by running a series of site analysis transects in several different vegetation types to be analyzed on the allotment. Following these preliminary runs, he will proceed through the allotment making a site analysis in at least every fifth classification. Measurable factors will include plant composition, forage production, percent vegetal and litter cover, bare ground, and soil erosion. Soil profile characteristics and substratum material will also be determined as well as an estimate of potential production. This information will be recorded on form R4-2200-13, Site Analysis. See Exhibit 41-A for equipment needs.-*

*-41.1 - Laying Out the Transect.

1. Size of Plots. Plot size should be gauged to fit the type of vegetation. Circular plots of .96, 1.92, 4.8, or 9.6 square feet area may be used. One of the smaller plot sizes should be used on the meadows and grasslands, while larger size plots will be necessary where individual plants are large and clumpy or the vegetation is sparse. The most efficient size plot should be used. Consider the time element as well as degree of accuracy. Studies in Montana found that a 2-square-foot circular plot was the most efficient for estimating herbage production in bunchgrass ranges (Ecology 44(4), p. 758).

2. Plot Interval. This will depend on the size of the type being sampled and the number of plots. First, decide on a direction of travel to be followed. Next, determine the approximate distance across the type from the aerial photos. Then select a plot interval that will space the plots completely across the type. An interval of one or two chains will be adequate on most types where 30 plots are used. A plot interval of less than a chain may be necessary on small meadows. If 30 plots are to be used, an acceptable alternative is to arrange the transect in three 10-plot groups situated at different levels or areas on the site being sampled.

3. Number of Plots. To estimate forage production and percent Desirables, Intermediates, and Least Desirables, the following number of plots should be used. For the .96 and 1.92 square-foot sizes, 30 plots should be used per transect, except in uniform meadows where 10 plots will be sufficient. For 4.8 or 9.6 square-foot sizes generally 10 plots should be used per transect, except in very sparse or clumpy vegetation where 20 plots will be used.

4. Selecting Plots. Locate plots along a transect line by pacing or measuring.

a. Pacing. Pace along a line towards some selected object in the foreground. As the plot site is approached, keep eyes on the guide object to avoid bias in selecting plot location. Place the "plot ring" directly in front of toe at completion of the last pace.

b. Measuring. In areas of heavy brush, measure the plot interval and remain on compass or tape line.

41.2 - Instructions for Recording Information on Site Analysis, Form R4-2200-13. (See example, Exhibit 41-B.)

41.21 - Sampling Herbage Production. Through a combination of weighing and estimating, the weight of herbage (in grams) both remaining and consumed is determined for each species within each plot. Names of species occurring in the plots are listed by appropriate symbol printed in capital letters.-*

*-1. Vegetation to Include in Plot. All portions of the plants within the plot and the overhanging portion of outside plants which fall within the plot are considered in the determination. Portions of plants that extend outside the plot are not considered. (See Exhibit 41-C.) Record all current growth of browse plants which falls within the plot and is available to grazing animals.

2. Developing Weight Units. Portions of various plants will be weighed to develop weight units. Knowing the relative weight of each plant part is essential in estimating amount of forage removed. Some of the most usable weight units are stems, small plants, leaves, and weight per square inch basal area. Relation of leaf weight to stem weight aids in estimating. Ten to 20 similar plants or plant parts such as individual leaves or leaf clusters can be weighed together and the average weight developed. Weight estimates between 1/2 gram and 1 gram will be recorded as a gram; weight estimates less than 1/2 gram will be recorded as a trace. Traces will not be added in figuring total production of a transect.

3. Herbage Left and Herbage Consumed. Herbage production is the sum of plant material removed and that remaining. Weigh or estimate the weight in grams of the remaining portions of each species in the plot. Estimate the weight in grams of the amount of each forage plant consumed by grazing animals. Compare grazed with ungrazed plants to develop proficiency in estimating. Record the sum of these two weights in the space provided on the form.

4. Total Herbage Sample. The "Total" column is the sum of the ten-plot yield estimates (remaining and consumed) in grams. Where more than 10 plots are run on a site, form R4-2200-13 need not be completed beyond the "Total" column. The rest of the computations will be done on summary form R4-2200-14.

5. Dry Weight Percent. An estimate of dry weight content in percent will be recorded for each species. The guides on the back of form R4-2200-13 may be used. However, the dry weight tables in Exhibit 41-D will give a higher degree of accuracy. Where more guidance is needed, make actual dry weight determination by collecting and air drying samples of the species.

41.22 - Overstory Vegetal Cover.

1. Tree Overstory. Estimate the percent overstory of trees on each plot.

2. Shrub Overstory. Estimate the percent overstory of the shrubs within each plot.

3. Herbaceous Crown Cover. This determination is for tall forb communities. The examiner will look straight down on the plot and estimate the percent of the plot which is covered by undisturbed vegetation. This determination should not be made after an area has received more than light grazing.-*

41.23
~~41.24~~

*-41.23 - Ground Cover Determination. Percentage of bare ground, pavement, rock, vegetation, and litter is determined in one operation. Each is shown as a percentage of the area within the plot. The total must equal 100 percent. These determinations are made by ocular estimates aided by a circular hoop 1/10 the size of the plot being used. Normally, estimates of ground cover items will be rounded to the nearest 5 percent.

1. Bare Ground. Exposed soil within the plot is classified as bare ground. The amount of bare ground will be expressed in terms of percentage of total plot area. Soil and rock particles less than 1/8 inch in diameter will be classed as soil, except in granitic soils where particles up to 1/4 inch in diameter will be considered as soil.

2. Pavement (1/8" - 3/4" diam.). Stone fragments of 3/4-inch diameter or less are generally ineffective in protecting the soil surface from erosive forces. Consequently, the percentage in this category will not be considered as ground cover. An exception to this is where fragments of this size form a mat of effective cover. In this latter case, percentages in this category will be tallied as ground cover.

3. Rock and Pavement (Larger than 3/4" diam.). Stone fragments and rock larger than 3/4-inch diameter generally provide protection to the soil surface beneath them and will be considered a part of the natural ground cover.

4. Vegetation. In most cases, only the basal area of herbaceous plants will be considered in determining ground cover. Exceptions are mat-forming plants such as Antennaria, Phlox, Silene, moss and lichens. In such cases the entire plant will be counted. Only the basal area of rosette plants such as Taraxacum and Agoseris will be counted as ground cover. Vegetation and litter may be recorded as a single combined entry if so desired.

5. Litter. Litter will be classed as ground cover, but will be considered complete cover only when no bare soil is showing. If bare soil is showing through litter, the litter will be given its proportionate value in ground cover determination. Litter cover will be based on past years' accumulation and not on current material. Litter must be in contact with the ground to be effective as ground cover.

41.24 - Dropping Counts and Use Intensity Determinations.

1. Dropping Counts. Use intensity will be based upon chip and pellet group counts. Depending upon the amount of use that has been made at time of study, it may be desirable to base this data on the previous years' droppings. Chip and pellet group information can be obtained by using the following types of plots.-*

*-a. Circular Plots. These plots have a radius of 11.7 feet and an area of 1/100 acre. They should have the same center as the vegetal plots of the analysis transect. The circular plot is well adapted for use with the weight estimate site analysis plots.

b. Strip Plots. Strips 6.6 feet wide and one chain long make a 1/100th-acre plot. These strip plots can be run very rapidly. A tally register and 6-foot tape or carpenter rule increase the accuracy and speed of the procedure. Converting factors for chips and pellet groups are found on the back of form R4-2200-13. (See example, Exhibit 41-B.)

2. Use Intensity Determinations. In the space provided on the lower back of the form, calculate days use per acre for each class of animal involved. Formulas for converting dropping counts to days of use are also found on the back of the form.

41.25 - Soil and Erosion Data. Soil and erosion data are gathered to determine the hydrologic condition of the site and its potential for runoff and erosion, and as an index to the productive potential of the site. This data is placed on the back of form R4-2200-13. (See example, Exhibit 41-B.)

1. Soil. Soil data will include texture, thickness of surface and subsoils, pH, coarse fragment content, substratum material, and effective rooting depth of plants.

a. Textural Classes. Sand, sandy loam, loam, silt loam, clay loam, and clay will be used. See Exhibit 41-E, for descriptions of these soil texture classes.

b. Thickness. Although undulations occur in most horizon boundaries, the average thickness of the surface horizon or horizons will be recorded to the nearest inch. Many of the thicker subsoils may not be fully examined; for these instances record the thickness observed and add a plus sign to the figure (example, 15"+). Be sure to record thickness and not depth.

c. pH. Record the soil reaction in terms of pH to the nearest 0.5 unit.

d. Percent Coarse Fragment Content by Volume. The amount of coarse fragments in the soil profile have a direct effect upon the effective rooting volume and moisture holding capacity of a soil. As coarse fragments increase in volume, the rooting and moisture holding capabilities are reduced proportionately.-*

*-Coarse fragments include both gravel and stone. Gravel is defined as fragments ranging from about .1 inch up to 3.0 inches in diameter; stones are fragments 3.0 inches and greater in diameter.

Estimate to the nearest 10 percent, the total volume occupied by gravel and stone. Make separate estimates for the surface and subsurface portions of the soil profile.

e. Substratum Material. Record type of underlying rock and/or soil material and its character. Examples include impermeable shale bedrock; permeable limestone formation; well-weathered, massive granite; very stony, sandy morainal material; dense caliche layer; highly fractured quartzite; gravel beds; and stone and medium-textured soil mixture, very strongly acid. If not observed, indicate the assumed or apparent materials. (See Exhibit 41-F for a list of common rocks.)

f. Effective Rooting Depth. As observed in the big sagebrush and grass types, the effective rooting depth is measured to that line or relatively narrow zone of demarkation which falls between those upper horizons in which roots are present in abundant, plentiful, or few numbers; and the lower horizons in which the roots are absent or present in very few numbers. The effective rooting zone usually coincides with a distinct change in character of horizons such as abruptly encountering a bedrock, hardpan, or gravel formation; changing from relatively low stone content to relatively high stone content; a pronounced change in soil reaction; or lithologic discontinuities within the mantle.

2. Erosion Patterns. To eliminate the use of interpretive classes such as slight, moderate, or severe, an estimate of the apparent surface soil losses and the general extent of gullying is recorded. Additional information about the erosion patterns, trends in stability, or significance of wind erosion, may be recorded in the remarks.

Indicators of erosion are:

a. Soil remnants
b. Erosion pavement
c. Lichen lines on rocks
d. Active gullies
e. Wind-scoured depressions
f. Aeolian deposits
g. Alluvial deposits
h. Exposed plant roots

3. Inherent Erosion Hazard. Information needed to make the soil erodibility appraisals is shown in Exhibit 41-G. In this study, the inherent erosion hazard will be considered to be mainly a function of soil erodibility and slope gradient. The following slope groups will tentatively represent five classes of topographic hazard:-*

*- 0 - 4%	I
5 - 29%	II
30 - 49%	III
50 - 67%	IV
68%+	V

4. Soil Disturbance. Trampling by livestock or big game results in soil disturbance, which is characterized by both soil displacement and compaction. Soil displacement is a factor of concern on light or loose soils, particularly on slopes. Compaction is common on heavier soils and on level areas. Both can be damaging.

a. Soil Displacement. Trampling activity on the sandier soils will result in displacement rather than compaction. The effects are most pronounced under dry conditions when considerable amounts of soil may be "walked" downslope in this manner. Soil displacement will be judged as being either none, light, moderate, or heavy and will be recorded on the back of the form. The rating will be based on the total area affected.

None	less than 1 percent
Light	1 to 10 percent
Moderate	11 to 30 percent
Heavy	over 30 percent

b. Soil Compaction. The commonly used measure of compaction is bulk density. Without laboratory determinations, compaction is often difficult to appraise--especially in the initial stages. Increased density of the immediate surface layers will be appraised in range analysis by careful visual examination of the structure and examination of the consistence. The surface structure and consistence of soils in grazed areas will be compared to the structure and consistence of similar sites and soils of adjacent protected areas. Soil compaction will be judged as being either none, light, moderate, or heavy.

41.26 - Cover Dispersion. Page 29 of Agricultural Handbook No. 19, Ellison and Croft, states, "A characteristic of normal cover is a high degree of dispersion, which, for effective soil protection is as important as a large amount of cover."

A measure of dispersion (dispersion rating) is obtained by calculating the spread in percentage of bare ground between the second highest and second lowest plots on each ten-plot transect. The second highest and second lowest plots are used in order to eliminate the extremes from the sample. However, if two or more plots show the same low or high reading, then these plots are used in calculating the dispersion rating, rather than the second highest and second lowest plots. For example, if two plots on a transect show 10 percent bare ground and two show 90 percent and these are the low and high readings, then these plots are used in computing the dispersion-*

41.27
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*-rating rather than the second lowest and second highest plots. For transects wi' more than ten plots, a rating is calculated for each 10-plot group and the results averaged to give an overall rating.

21.27 - Composition and Desirability Ratings. The following calculations for 10-plot transects are performed on form R4-2200-13; calculations for transects with more than ten plots are performed on form R4-2200-14.

1. Green Weight Herbage Production. Green weight production is converted from grams per transect to pounds per acre using the appropriate formula printed on the back of form R4-2200-13. Choice of formula varies with the size and number of plots involved.

2. Dry Weight Herbage Production. Convert green weight to dry weight. This is done by multiplying the pounds green weight production per acre times the percent dry weight content expressed as a decimal. The result is pounds dry weight production per acre.

3. Percent Composition. Percent composition is determined on a dry weight basis. Divide the total dry weight of each species by the total dry weight production of all species on the transect, times 100, to get percent composition of each species.

4. Desirability Rating. Desirability rating of the species will be based on the appropriate species list. (See Exhibits 41-H and 41-I). These will be designated as follows: "D" (Desirables), "I" (Intermediates), "L" (Least Desirables). Percent composition of each species will be recorded in the proper desirability rating column on the form. Where the desirability rating is split for a given species, show the share of each rating thus; e.g., "D" - 5%, "I" - 13%. Total the columns for percentage of Desirables, Intermediates, and Least Desirables.

41.28 - Rating Condition and Apparent Trend.

1. Condition Rating. Condition based on vegetation and soil stability ratings will be recorded on form R4-2200-13. Each will be based on 100 points.

a. Vegetation Condition Rating. Vegetation condition will be based on composition, vigor, and cover; the latter two are reflected in production. The composition rating and production rating will be added to give the vegetation condition rating, composition receiving a maximum of 60 points and production a maximum of 40 points. -*

*-(1) Composition. The composition rating is governed by the percentage of "Desirable," "Intermediate," and "Least Desirable" species occurring in the stand. The rating is determined from the "Guide for Rating Vegetal Condition," Part A, (see Exhibits 41-J and 41-J1).

(2) Production Rating. Part B of the "Guide for Rating Vegetal Condition," will be used to determine the production rating for the site. Only "Desirables" and "Intermediates" will be used in making this determination (see Exhibits 41-J and 41-J1).

b. Soil Condition Rating. Soil condition rating will be based on a combination of the "ground cover index" and "current erosion index," each receiving a maximum of 50 points. The ratings of the two will be added to give the soil condition rating.

(1) Ground Cover Index. The ground cover index is based on the amount of ground cover and the dispersion rating. If the dispersion rating for a site is below that shown in the ground cover index for the site, the ground cover index rating will be reduced five points for each dispersion rating below that indicated in the appropriate ground cover index. Use Part I of "Guide for Rating Soil Condition" to classify ground cover index. The ground cover index is not adjusted if the dispersion rating is above that shown in the ground cover index for the site (see Exhibits 41-K or 41-L).

(2) Current Erosion Index. Classify current erosion index on the basis of Part II of the appropriate "Guide for Ratina Soil Condition" (current soil erosion). (See Exhibits 41-K or 41-L.)

2. Apparent Trend. Apparent trend in soil stability and vegetation will be determined separately for each area on which site analyses are made. The following symbols will be used to denote apparent trend: ↑ up; ↓ down; → not apparent. An example of an apparent trend rating for a definite classification follows:

SI $\frac{65 \rightarrow}{45 \downarrow}$ =Suitable grassland range in good vegetal condition with no apparent trend. Soil stability fair with a downward trend.

Trend will be determined from trend transects when they are available. Apparent trend will be judged using the "Apparent Trend Guides." (See Exhibit 41-M and the discussion in Chapter 30 for further information.)

3. Classification of Browse. As a means of correlating livestock and game range analysis, the important browse species from the game management standpoint-*

*-will be classified as to condition and apparent trend. This determination is in addition to the range analysis condition classification. For details of browse classification, see Chapter 90, Section 93.3.

4. Production Estimates.

a. Production of "D" and "I" Plants. This is a calculation of forage production based only upon "Desirable" and "Intermediate" plants. It is accomplished by adding the percentage of "Desirable" and "Intermediate" plants in the composition and multiplying this sum by the total dry weight production per acre.

b. Estimated Potential Production. Record your estimate of potential dry weight production for the site. Base estimate upon relic area information, condition standards for comparable sites, or production studies from comparable range in good condition including seedings. (See the appropriate condition standard in Chapter 30.)

41.29 - Reasons for Suitability Classification. The examiner must specify his reasons for all unsuitable-used classifications and for those suitable classifications which raised a question in the examiner's mind. Reasons need not be stated for classification of obviously suitable types. Document reasons on the back of the writeup sheet.

Reasons for a suitability classification may summarize and refer to inventory data found elsewhere on the writeup form. Examples of this type of information include such characteristics as inherent erosion hazards, use intensities, slopes, and soil disturbance. Reasons may also relate to evaluation of things observed on the site but not specifically recorded as inventory data. These reasons could include such things as (1) relationship of slope and slope length to water location,(2) distributional habits of the livestock, (3) site potentials, and (4) multiple use coordinations.

The stated reasons may refer to items in locally developed suitability criteria provided the basis for such criteria are well supported and documented.

Generally, reasons for a suitability classification are based on characteristics inherent to the site being studied and/or to adjoining sites whose use is interrelated.-*

*-41.3 - Site Analysis Summary, Form R4-2200-14. Where more than 10 plots are taken on a site, the information will be summarized on form R4-2200-14 (see Exhibit 41-N).

1. Transferring Data From the Site Analysis Forms. Data from the "Species," "% Dry Wt.," and "Total" columns of form R4-2200-13 will be transferred to the summary form. There is room for summarizing the data from a maximum of three site analysis forms. Total all data in the column headed "Total."

2. Green Weight Herbage Production. (See Section 41.27.) Formulas for converting grams per transect to pounds per acre are printed on the backs of both form R4-2200-13 and R4-2200-14.

3. Completion of Summary Form. The rest of the computation will follow the same procedure described for form R4-2200-13. (See Sections 41.27, 41.28, and 41.29.) Where more than one site analysis (form R4-2200-13) is run, the data on the back of the form need only be completed on the summary form or on one of the site analysis forms.-*

RANGE ENVIRONMENTAL ANALYSIS HANDBOOK

*-41.4 - List of Exhibits.

Exhibit Number	Name of Exhibit
41-A	Equipment Required to Make Site and Ocular Analysis
41-B	Site Analysis, form R4-2200-13
41-C	Crown Cover and Ground Cover Illustrations
41-D	Dry Weight Conversion ıbles
41-E	Soil Texture Classes
41-F	List of Common Rocks
41-G	Soil Erodibility Appraisals
41-H	Species List (General)
41-I	Species List (Alpine)
41-J	Guide for Rating Vegetal Condition
41-J1	Graphic Guide for Rating Vegetal Condition
41-K	Guide for Rating Soil Condition - Parts I and II
41-L	Guide for Rating Soil Condition (Alpine) - Parts I and II
41-M	Apparent Trend
41-N	Site Analysis Summary, form R4-2200-14-*

*-**Exhibit 41** - A

EQUIPMENT REQUIRED TO MAKE SITE AND OCULAR ANALYSIS

1. Hoops for use in defining circular plots of desired size.
   a. Circumference of the various sizes of hoops

      .96 sq. ft. = 41.7 inches — $41\frac{45}{64}$
      1/10th guide or .096 sq. ft. = 13.2 inches

      1.92 sq. ft. = 59.0 inches —
      1/10th guide or .192 sq. ft. = 18.6 inches

      4.8 sq. ft. = 93.2 inches —
      1/10th guide or .48 sq. ft. = 29.5 inches

      9.6 sq. ft. = 131.8 inches

   b. Material — No. 9 telephone wire w/No. 9 copper clad steel connected with a nicopress sleeve. Surplus control cable from aeroplanes is also excellent material.
2. Oxwall 200-gram spring balances with 2-gram graduation.
3. Six by ten-inch cloth sack or small plastic bag.
4. One hundred-foot tape and "Jake Staff" are needed where browse cover is being studied.
5. Letter-size tatum holder, clipboard, or aluminum holder.
6. Forms R4-2200-13 (Site Analysis), R4-2200-14 (Site Analysis Summary), R4-2200-10 (Ocular Analysis).
7. An 11.7-foot cord with a spike tied on one end for measuring 1/100-acre plots.
8. Pocketknife or shears for clipping vegetation.
9. A six-foot tape or carpenter rule.
10. Pocket stereoscope.
11. Aerial photos with frosted overlays attached.
12. Shovel.
13. pH kit.
14. Plastic squirt bottle.-*

RANGE ENVIRONMENTAL ANALYSIS HANDBOOK

*-Exhibit 41-B

SITE ANALYSIS

WRITEUP NO.						PHOTO NO.
J4						CVX-9V-15
FOREST	RANGER DISTRICT	ALLOTMENT	EXAMINER	DATE		
02-BANNOCK	03-INDIAN HEAD	COYOTE CREEK	Wm. Jones	8/7/68		
TRANSECT NO.	PLOT SIZE	PLOT INTERVAL	TYPE DESIGNATION	KIND OF LIVESTOCK	SLOPE	EXPOSURE
1 of 1	9.6	1 ch.	S5 33/53 → ↓	SHEEP	35	W
LOCATION IN THE HEAD OF BIRCH CREEK.						ELEVATION 9500

	SPECIES	% DRY WT	PLOTS 1	2	3	4	5	6	7	8	9	10	TOTAL	OMIT IF SUMMARY FORM IS USED: *GREEN WT./AC.	DRY WT./AC.	% COMP	DESIRABILITY RATING D	I	E
GRASSES	BRMA	50	20		1		5	5	5	5	4	3	48	48	24	1	1		
	AGTR	50	12	20	2			4	10	10	15	5	78	78	39	2	2		
	MEBU	50		3	1								4	4	2	T			
	STLE	50					40						40	40	20	1		1	
	PORE	50			2								2	2	1	T			
	POFO	30	110	110	40	3		45	25	70	4	100	507	507	152	9	5	4	
	HAFL	30	15	25	8		2	140				10	200	200	60	4	4		
	COLI	30	4		1	5						6	16	16	5	T			
	STJA	30	5	5	3	4	4	6	18		4		49	49	15	1			1
	VIPU	30	3	15	4	3	8	15	20	10	4	15	97	97	29	2		2	
	ANNFO	30	3										3	3	1	T			
	THFE	30	8	5		5		35	15				68	68	20	1	1		
	ACMIL	30	4					10					14	14	4	T			
FORBS	PODOD	30	2		5	20	3		15		6		51	51	15	1			1
	CHAL	30		5						3			8	8	2	T			
	DELPH(L)	30		3	4	8	2		8	15	6	15	61	61	18	1		1	
	MAGL	30			1	25	20				40		86	86	26	2			2
	DESCU	30			T								T	T	T				
	LUAL	30					6						6	6	2	T			
	ASTER	30					3						3	3	1	T			
	HEHO	30						70					70	70	21	1			1
	POTEN	30						6					6	6	1	T			
	VIMU	30	10	35	15	3	8	25	30	30	5	25	186	186	56	3		3	
	CBT																		
BROWSE	ARTR-P →	50	130										130	130	65	4		4	
	SARP2-G →	35	45	450	40	25		810	720	600	60	480	3230	3230	1130	67	10	15	42
	TOTALS												4963	4963	1709	XXXX	23	30	47

% OVERSTORY (TREES)											
% OVERSTORY (SHRUB)	20	65	20	15		100	90	85	25	60	53
% CROWN COVER (HERB)											
% BARE GROUND	40	15	70	80	30	20	20	35	70	35	42
% PAV. (¼" – ¾" DIAM.)											
% ROCK & PAV. (¾" >)						10					1
% VEGETATION	10	25	15	5	30	25	20	15	10	25	18
% LITTER	50	60	15	15	40	45	60	50	20	40	39
CHIPS											
PELLET GROUPS S	1	5	3	3	7	1	2	4	6	2	34

CONDITION RATING

COMPOSITION RATING 13

PRODUCTION RATING 20

FORAGE CONDITION RATING 33

GROUND COVER INDEX 20

CURRENT EROSION INDEX 33

SOIL CONDITION RATING 53

APPARENT TREND VEG → SOIL ↓

BROWSE CONDITION G

APPARENT TREND →

* CALCULATED BY FORMULA FOUND ON REVERSE OF THIS FORM

D&I PRODUCTION 906 LBS PER ACRE (DRY WT.)

EST. POTENTIAL PROD. FOR SITE 1800 LBS PER ACRE (DRY WT.)-*

FORM R4-2200 13 (11-68)

RANGE ENVIRONMENTAL ANALYSIS HANDBOOK

*SOIL SURFACE TEXTURE Silt Loam, THICKNESS 8", pH 6.0
SUBSOIL TEXTURE Stony Clay Loam, THICKNESS 22"+, pH 7.0

% COURSE FRAGMENT CONTENT BY VOLUME: SURFACE 0, SUBSURFACE 40
SUBSTRATUM MATERIAL Calcic Sandstone, EFFECTIVE ROOTING DEPTH 29"
REMARKS Rooting zone ends quite abruptly.

EROSION PATTERN: SURFACE LOSSES AVERAGE 2 INCHES OVER 30 % OF THE AREA
GULLIES TOTAL APPROXIMATELY — FEET IN LENGTH AND AVERAGE ABOUT — FEET DEEP
REMARKS Evidence of sheet erosion over 1/3 of type.

INHERENT EROSION HAZARD: DETACHABILITY RATING 7, SURFACE COVERED WITH ROCK FRAGMENTS ¼ INCH OR GREATER IN DIAMETER 0 %, ADJUSTED DETACHABILITY RATING 7
PROFILE PERMEABILITY RATING 7, SOIL ERODIBILITY INDEX 49, CLASS IV
SLOPE 35 %, INHERENT EROSION HAZARD, CLASS IV

SOIL DISTURBANCE: COMPACTION None (NONE, LIGHT, MODERATE, HEAVY)
DISPLACEMENT Light (NONE, LIGHT, MODERATE, HEAVY)

COVER DISPERSION: UNIFORM ____ FAIRLY UNIFORM ✓ VARIABLE ____ HIGHLY VARIABLE ____
GROUND COVER PERCENT 58

GIVE REASONS FOR SUITABILITY CLASSIFICATION This area is suitable under light use but would be susceptible to erosion if ground cover is allowed to deteriorate. Should be rested periodically to allow litter accumulation to increase.

AIR-DRY CONTENT OF GREEN FORAGE

GRASSES & SEDGES	
JUST BEFORE HEADING	25 - 30 %
HEADED OUT	35 - 40 %
AFTER BLOOM	45 - 50 %
SEED MATURITY AND PAST	55 - 80 %
FORBS	
VERY LUSH	15 - 20 %
FLOWERING	20 - 25 %
SEED TIME	30 - 35 %
BROWSE	
LUSH LEAVES (SNOWBERRY)	30 - 40 %
FIBROUS LEAVES (OAK) & PURSHIA	35 - 45 %
RABBITBRUSH & SAGEBRUSH	40 - 60 %

FORMULA TO CONVERT GRAMS/TRANSECT TO #/ACRE

PLOT SIZE	NUMBER OF PLOTS 10	20	30
.96	X10	X5	X10/3
1.92	X5	X5/2	X5/3
4.8	X2	DIRECT	X2/3
9.6	DIRECT	÷ 2	÷ 3

ESTIMATED USE BASED ON DROPPINGS COUNT

CONVERSION FACTORS:
13 PELLET GROUPS PER SHEEP DAY
12 CHIPS PER COW DAY
PLOT SIZE 1/100 ACRE
A. 3.3 FT. ON EACH SIDE OF TRANSECT LINE
OR
B. SUPERIMPOSED CIRCULAR PLOT WITH AN 11.7 FT. RADIUS

FORMULA FOR A
$\frac{\text{DROPPINGS PER TRANSECT}}{\text{CHAINS PER TRANSECT}} \times \frac{100}{12} = \text{COW DAYS PER ACRE}$

FORMULA FOR B
AVERAGE DROPPINGS PER PLOT $\times \frac{100}{12} = \text{COW DAYS PER ACRE}$

CALCULATIONS
$34/10 \times 100/13 = 3.4 \times 100/13 = 340/13$

$$13\overline{)340.0}\quad 26.1$$
$$26$$
$$80$$
$$78$$
$$20$$

COW DAYS PER ACRE ____
SHEEP DAYS PER ACRE 26.1
GAME DAYS PER ACRE D ____
E ____
M ____ -*

*-Exhibit 41-C

CROWN COVER AND GROUND COVER ILLUSTRATIONS

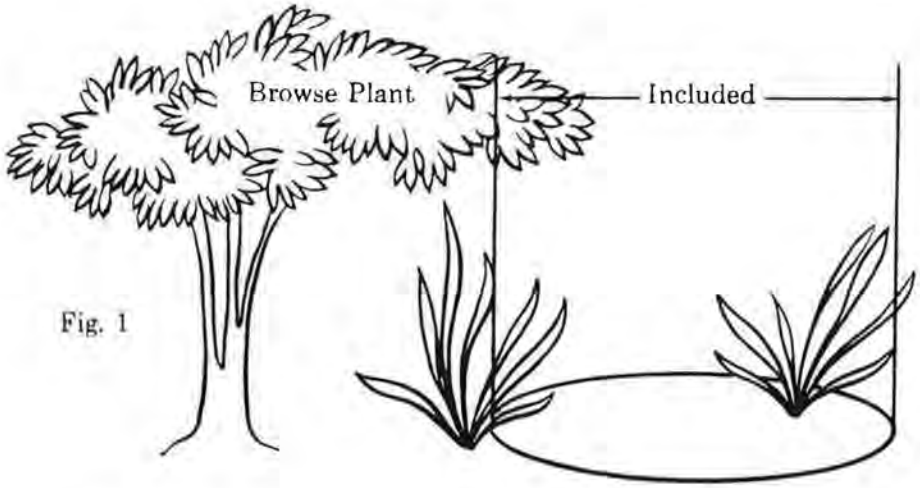
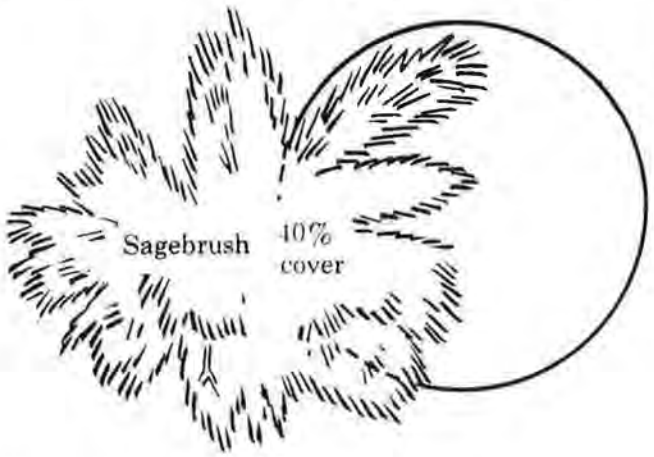


Fig. 1

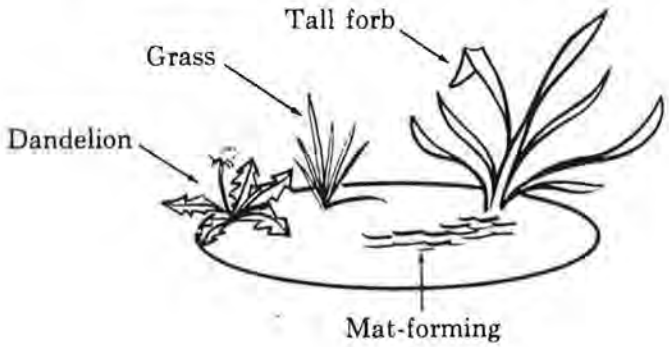
Estimates include all portions of plants within the plot. The upright lines illustrate portions considered in the estimate.

Fig. 2 Crown cover is estimated in percent of the plot for all shrubs.



Plot as viewed from above.

Fig. 3 Ground cover determination.



Based on basal area of most plants. The exception would be mat-forming such as *Phlox*, *Silene*, *Antennaria* and others.-*

*** - Exhibit 41 – E**

SOIL TEXTURE CLASSES

From Soil Survey Manual
U.S.D.A. Handbook 18

Sand: Sand is loose and single grained. The individual grains can be readily seen or felt. Squeezed in the hand when dry it will fall apart when the pressure is released. Squeezed when moist, it will form a cast, but will crumble when touched.

Sandy loam: A sandy loam is a soil containing much sand but which has enough silt and clay to make it somewhat coherent. The individual sand grains can readily be seen and felt. Squeezed when dry, it will form a cast which will readily fall apart, but if squeezed when moist a cast can be formed that will bear careful handling without breaking.

Loam: A loam is a soil having a relatively even mixture of different grades of sand and of silt and clay. It is mellow with a somewhat gritty feel, yet fairly smooth and slightly plastic. Squeezed when dry, it will form a cast that will bear careful handling, while the cast formed by squeezing the moist soil can be handled quite freely without breaking.

Clay loam: A clay loam is a fine-textured soil which usually breaks into clods or lumps that are hard when dry. When the moist soil is pinched between the thumb and finger, it will form a thin "ribbon" which will break readily, barely sustaining its own weight. The moist soil is plastic and will form a cast that will bear much handling. When kneaded in the hand, it does not crumble readily but tends to work into a heavy compact mass.

Clay: A clay is a fine-textured soil that usually forms very hard lumps or clods when dry and is usually quite plastic and sticky when wet. When the moist soil is pinched out between the thumb and fingers it will form a long, flexible "ribbon". Some fine clays very high in colloids are friable and lack plasticity in all conditions of moisture.-*

*- Exhibit 41 -F

LIST OF COMMON ROCKS

1. *Igneous* — Rock solidified from molten lava.
   a. *Granite* — Predominantly light-colored, coarse-grained rock.
   b. *Syenite* — The same as above except it contains no quartz.
   c. *Rhyolite* and *Trachite* — Light-colored, very fine-grained rock.
   d. *Diorite* and *Gabbro* — A coarse-grained rock made up of a near even mixture of light and dark minerals.
   e. *Dacite* and *Andesite* — Same as "d" except the grain is very fine.
   f. *Basalt* — Generally fine-grained rock varying in color from medium to dark.
   g. *Pyroxenite* and *Peridotite* — Very dark, coarse-grained rock.
   h. *Tuff* — A light-colored and very light-weight rock.
2. *Sedimentary* — From deposition by such agents as water, wind and organisms.
   a. *Limestone* — Light gray to black, generally fine-grained.
   b. *Dolomite* — Similar to limestone.
   c. *Shale* — Various colored, slaty to clay-like, soft.
   d. *Sandstone* — Generally gray, granular, very hard.
   e. *Conglomerate* — Large and small pebbles cemented together.
3. *Metamorphic* — Formerly sedimentary or igneous but changed by pressure, heat, or water.
   a. *Gniess* — Light to dark gray, fine to coarse-grained, banded.
   b. *Quartzite* — Similar to sandstone except that it breaks across the grain.
   c. *Schist* — Light to dark gray, made up of scaly layers.
   d. *Slate* — Dark, slaty.

For further information, see Handbook on Soils (2512.5), pages 30-47. -*

*-Exhibit 41 - G

SOIL ERODIBILITY APPRAISALS

In order that the scope of study be thoroughly understood, we will first briefly consider the primary factors that influence soil erosion by water. Outlined below are the four factors affecting erosion.

I. Climate (initial erosion energy)

- A. Storm frequency
- B. Storm intensity
- C. Storm duration

II. Soil (erodibility of the soil)

- A. Aggregate detachability — strength and size of the surface soil aggregates.
- B. Profile characteristics affecting the disposition of infiltrated water texture, depth, restricting layers, etc.
- C. Coarse fragments — surface gravel and stone.

III. Topography (erosiveness of the runoff)

- A. Runoff velocity — slope gradient, roughness
- B. Runoff quantity — slope length, slope shape

IV. Effectiveness of the erosion retardants

- A. Detachment reducers — vegetation, litter, mulches
- B. Transport reducers — litter, mulches, trenches, pits, dams, barriers, etc.

In this study the term "erosion hazard" will be reserved to encompass the overall erosion hazard by water on a given site — the hazard resulting from the combined effects of climate, soils, topography, and vegetation. The term "inherent erosion hazard" includes the effects of climate, soils, and topography, but excludes the protective effects of vegetation.

Soil erodibility is used to encompass only those characteristics and qualities of the soil that appear to be more or less controlling in providing stability or instability to a soil insofar as erosion by water is concerned. It is this factor of soils — the rating of soil erodibility — that is the principal concern of this study.

It is well known that soils vary in their ability to resist erosion. Most of this resistance, or lack of resistance, seems to be related to: (1) The stability of the surface soil aggregates, and (2) the ease with which the soil becomes saturated, thus forcing water to flow over the surface. If the surface soil aggregates are stable in a moist state, detachment by raindrop impact is minimized. If the soil mantle is permeable and allows a reasonably rapid infiltration and downward percolation of water, surface flows of excess water are less frequent. Any restriction to percolation in the soil such as increases of clay content, hardpans, compacted layers, or bedrock at shallow depths will prevent or retard the downward movement of water and consequently increase the erosion potential.-*

*-The method used for gathering the necessary appraisal data will be a squirt bottle test in conjunction with a soil profile description. The squirt bottle test involves subjecting a moistened soil aggregate of the surface horizon to one or more jets of water and noting the effort required to collapse the aggregate. The soil profile description will necessarily have to be brief and perhaps somewhat generalized, but of particular concern are the following items:

Profile characteristics affecting permeability — texture, structure, consistence, stone and root content of each horizon along with its thickness.

Coarse fragments on the surface — percentage estimate of the total fragments (> ¾ inch) exposed on the soil surface (or would be exposed if the vegetation and litter were removed).

Data Interpretation

The guide used in making this soil erodibility classification is based on an index system and in it are listed the criteria together with numerical values assigned to each class for the different criteria. The first portion of the guide evaluates surface aggregate detachability. In rating the detachability index, consider the surface layer just below where the organic layer and the root mat are dominating factors, and consider the largest primary unit of structure.

The second portion of the guide appraises the permeability of the soil profile, irrespective of the present vegetal cover. The criteria are for guidance only giving the usual trend for textural, permeability, and soil depth differences. Each man should expand or tailor these descriptions according to regional soil characteristics considered important as clues estimating permeability in the field.

Part III of the guide indicates the method by which the soil erodibility index is obtained.-*

*- TENTATIVE SOIL ERODIBILITY CLASSIFICATION GUIDE

I. DETACHABILITY CLASSES

	Detachability Index
Surface horizon aggregates STRONGLY resistant to detachment or dispersion; aggregates dominately GREATER THAN 2 mm. in diameter after wetting; moistened aggregates maintain their stability when washed repeatedly by a fine stream of water from a plastic wash bottle.	1 or 2
Surface horizon aggregates STRONGLY resistant to detachment or dispersion; aggregates dominately LESS THAN 2 mm. in diameter after wetting.	3 or 4
Surface horizon aggregates MODERATELY resistant to detachment or dispersion; moistened aggregates soon become completely detached or dispersed when repeatedly washed by a fine stream of water.	5 or 6
Surface horizon aggregates WEAKLY resistant to detachment or dispersion; aggregates begin to collapse when first moistened or are readily detached with first wash of a fine stream of water from a plastic wash bottle.	7 or 8
Surface horizon NOT aggregated but is single grain; particles in a detached state.	9 or 10-*

*-II. PROFILE PERMEABILITY RATINGS

Permeability of Surface Horizon(s)	Reduction of Permeability in Lower Horizon(s)	Depth at Which Permeability Reduction Begins			
		Less Than 6"	6-18"	18-36"	Greater Than 36"
		PROFILE PERMEABILITY INDEXES			
Rapid (sands, loamy sands)	Little or No Reduction[1]				1 or 2
	Moderate Reduction[2]	5 to 7	3 or 4	2 or 3	1 or 2
	Pronounced Reduction[3]	8 to 10	5 to 7	3 or 4	1 or 2
Moderately Rapid (sandy loams, very gravelly loams)	Little or No Reduction				3 or 4
	Moderate Reduction	7 to 8	5 or 6	4 or 5	3 or 4
	Pronounced Reduction	9 or 10	7 or 8	5 or 6	3 or 4
Moderate (loams, silt loams)	Little or No Reduction				5 or 6
	Moderate Reduction	7 to 8	6 or 7	5 or 6	5 or 6
	Pronounced Reduction	9 or 10	7 or 8	6 or 7	5 or 6
Moderately Slow (clay loams, silty clay loams, very granular clay)	Little or No Reduction				7 or 8
	Moderate Reduction	8 or 9	7 or 8	7 or 8	7 or 8
	Pronounced Reduction	9 or 10	7 or 8	7 or 8	7 or 8
Slow (clay, silty clay)	Little or No Reduction				9 or 10
	Moderate Reduction	9 or 10	9 or 10	9 or 10	9 or 10
	Pronounced Reduction	9 or 10	9 or 10	9 or 10	9 or 10

[1]*Also includes those profiles whose permeability increases in the lower horizons.*

[2]*Commonly includes those profiles with increase of one textural class from A to B horizon; somewhat previous substrata, etc.*

[3]*Commonly includes those profiles with abrupt, pronounced development in B horizon — increase of more than one textural class from A to B horizon; impervious substrata such as hardpans, strong fragipans, slightly or unfractured bedrock, etc.* -*

*-III. SOLUTION

1. Reduce the detachability index by the percentage of coarse fragments (> 3/4 inch diameter) on the surface.

2. Obtain the soil erodibility index by multiplying the adjusted detachability index by the profile permeability index.

3. Soil Erodibility Ratings:

Soil Erodibility Index	Adjective Rating	Class Rating
0 - 6	Very Low	I
7 - 20	Low	II
21 - 40	Moderate	III
41 - 70	High	IV
71 - 100	Very High	V

A class III topographic hazard associated with a class III soil erodibility index will result in a class III (moderate) inherent erosion hazard. Lower or higher topographic hazard classes associated with class III soil erodibility index may result in class I or II, or class IV or V, depending on the actual slope steepness. The topographic hazard may be adjusted according to length, shape and roughness of slope. These additional factors or characteristics may be such as to justify raising or lowering the topographic hazard class one full class, as determined from slope gradient alone.-*

RANGE ENVIRONMENTAL ANALYSIS HANDBOOK

*-Exhibit 41 - H

Species List

General

Symbol		Desirable	Intermediate	Least Desirable
	GRASSES			
AGROP	Agropyron spp. (Other)	0-30	30+	
AGCR	A. cristatum	X		
AGSA	A. saxicola	0-30	30+	
AGSM	A. smithii	0-20	20+	
AGSP	A. spicatum	0-30	30+	
AGSPI	A. " inerme	0-30	30+	
AGSU	A. subsecundum	X		
AGTR	A. trachycaulum	0-20	20+	
AGRO2	Agrostis spp. (Other)	X		
AGAL	A. alba	X		
AGDI	A. diegoensis	0-40	40+	
AGSC2	A. scabra		X	
BLTR	Blepharoneuron tricholepis		X	
BOGR	Bouteloua gracilis	X		
BRIZA	Briza spp.		X	
BROMU	Bromus spp. (Other)	X		
BRAN	B. anomalus	X		
BRCA	B. carinatus	0-5	5+	
BRCI	B. ciliatus	X		
BRIN	B. inermis	X		
BRMA	B. marginatus	0-5	6-25	25+
BRPO	B. polyanthus	0-5	6-25	25+
BRTE	B. tectorum			X
BROMA	Other annual bromes			X
CALAM	Calamagrostis spp. (Other)	X		
CACAC	C. canadensis canadensis	0-20	20+	
CAPU	C. purpurascens	X		
CARU	C. rubescens	0-40	40+	

RANGE ENVIRONMENTAL ANALYSIS HANDBOOK

*-Exhibit 41 - H--Continued

Symbol		Desirable	Intermediate	Least Desirable
	GRASSES			
DAGL	Dactylis glomerata	X		
DANTH	Danthonia spp. (Other)	X		
DACA	D. californica	X		
DAIN	D. intermedia	X		
DAUN	D. unispicata		X	
DESCH	Deschampsia spp. (Other)	X		
DECA	D. caespitosa	0-40	40+	
DEDA	D. danthonioides			X
DEEL	D. elongata			X
ELYMU	Elymus spp. (Other)	X		
ELCI	E. cinereus	0-30	30+	
ELGL	E. glaucus	0-10	10+	
ELTRP	E. triticoides pubescens	0-30	30+	
ELTRS	E. " simplex	0-20	21-40	40+
FESTU	Festuca spp. (Other)	X		
FEEL	F. elatior	X		
FEID	F. idahoensis	0-30	30+	
FEOV	F. ovina	0-30	30+	
FETH	F. thurberi	0-40	40+	
* FEVI	F. viridula	0-40	40+	
GLYC	Glyceria spp.	X		
GLBO	G. borealis	X		
HEKI	Hesperochloa kingii	X		
HIJA	Hilaria jamesii	X		
HOLA	Holcus lanatus		X	
HORDE	Hordeum spp.		X	
HOBR	H. brachyantherum		X	
HOJU	H. jubatum			X
KOCR	Koeleria cristata	X		

*Toiyabe N.F.

RANGE ENVIRONMENTAL ANALYSIS HANDBOOK

*-Exhibit 41-H--Continued

Symbol		Desirable	Intermediate	Least Desirable
	GRASSES			
MELIC	Melica spp.(Other)		X	
MEBU	M. bulbosa	0-5	6-20	20+
*MEFU	M. fugax		X	
MESP	M. spectabilis	0-5	6-20	20+
MEST	M. stricta	X		
MUHLE	Muhlenbergia spp. (Other)	X		
MUFI	M. filiformis		0-5	5-
MUMO	M. montana	0-30	30+	
MURI	M. richardsonis		0-5	5+
ORYZO	Oryzopsis spp.	X		
ORHY	O. hymenoides	X		
PHLEU	Phleum spp.	X		
PHAL	P. alpinum	X		
PHPR	P. pratense	X		
POA	Poa spp. (Other)	X		
POBU	P. bulbosa		0-20	20+
POFE	P. fendleriana	X		
POPR	P. pratensis		X	
POSE	P. secunda (General)		0-20	20+
	P. " (low sagebrush community)	0-10	10-30	30+
SITAN	Sitanion spp. (Other)	X		
SIHY	S. hystrix	0-5	5+	
STIPA	Stipa spp.		X	
STCO2	S. columbiana	0-20	20+	
STCO	S. comata	0-20	20+	
STLE	S. lettermani		0-50	50+
STOC	S. occidentalis	X		
STSP2	S. speciosa		X	
TRISE	Trisetum spp. (Other)	X		
TRSP	T. spicatum	X		

*Toiyabe N.F.

*-Exhibit 41-H--Continued

Symbol		Desirable	Intermediate	Least Desirable
	GRASSLIKE PLANTS			
CAREX	Carex spp. (Others)	X		
CADO	C. douglasii		X	
* CAEX	C. exserta	0-50	50+	
CAFE	C. festivella	0-10	10+	
CAGE	C. geyeri	0-50	50+	
CAOB	C. obtusata		0-25	25+
CARO	C. rossii	0-10	10+	
ELEOC	Eleocharis spp.		X	
JUNCU	Juncus spp. (Other)	X		
JUBA	J. balticus		X	
JUDR	J. drummondii		X	
LUZUL	Luzula spp.	X		
	FORBS			
ACMIL	Achillea millefolium lanulosa (General)		X	
	A. millefolium lanulosa (Meadow)			X
ACCO	Aconitum columbianum	X		
AGUR	Agastache urticifolia	0-5	6-30	30+
AGOSE	Agoseris spp.		0-10	10+
ALLIU	Allium spp.		0-5	5+
ANAPH	Anaphalis spp.		X	
ANGEL	Angelica spp.	X		
ANNFO	Annuals (Other)			X
ANTEN	Antennaria spp.			X
APOCY	Apocynum spp.		X	
AQUIL	Aquilegia spp.	X		
ARABI	Arabis spp. (Other)		X	
ARDR	A. drummondii		X	
ARENA	Arenaria spp.			X
ARNIC	Arnica spp. (General)		X	
	A. spp. (Meadow)			X

*Toiyabe N.F.

RANGE ENVIRONMENTAL ANALYSIS HANDBOOK

*-Exhibit 41-H--Continued

Symbol		Desirable	Intermediate	Least Desirable
	FORBS			
ARCO	Arnica cordifolia	X		
ARLO2	A. longifolia		X	
ARTEM	Artemisia spp. (Other herb.)		X	
ARLU	A. ludoviciana		0-20	20+
ASTER	Aster spp. (General)		X	
	A. spp. (Meadow)			X
ASCHA	A. chilensis adscendens		0-20	20+
ASEN	A. engelmannii			
ASFO	A. foliaceus		X	
ASIN	A. integrifolius		X	
ASTRA	Astragalus spp. (Other)		X	
ASDI	A. diversifolius	X		
BAHI	Balsamorhiza hirsuta		X	
BAHO	B. hookeri		X	
BAMA	B. macrophylla	0-20	20+	
BASA	B. sagittata	0-20	20+	
BRODI	Brodiaea spp.		X	
CALOC	Calochortus spp.	X		
CALE	Caltha leptosepala	0-5	5+	
CAQU	Casmassia quamash	X		
CAMPA	Campanula spp.		X	
CASTI	Castilleja spp. (General)	X		
	C. spp. (Meadow)		X	
CACU2	C. cusickii		0-10	10+
CHAEN	Chaenactis spp. (Other)		X	
CHDO	C. douglasii		X	
CHVI	Chrysopsis villosa			X
CIDO	Cicuta douglasii		X	
CIRSI	Cirsium spp.			X
CLAYT	Claytonia spp.		X	
CLEM2	Clematis spp.		X	
COLLO	Collomia spp.			X
COPA	Comandra pallida		0-5	5+
CORDY	Cordylanthus spp.		X	
COCA5	Corydalis caseana		X	
CREPI	Crepis spp.	X		

*-Exhibit 41-H--Continued

Symbol		Desirable	Intermediate	Least Desirable
	FORBS			
CRYPT	Cryptantha spp.		X	
CYMOP	Cymopteris spp.		X	
CYOF	Cynoglossum officinale			X
DELPH (T)	Delphinium spp. (Tall)	0-10	11-20	20+
DELPH (L)	D. spp. (Low)		X	
DESCU	Descurainia spp.			X
DISPO	Disporum spp.		X	
DODEC	Dodecatheon spp.		X	
DRABA	Draba spp. (Perennial)		X	
EPILO	Epilobium spp. (Other)		X	
EPAN	E. angustifolium		X	
EQUIS	Equisetum spp.			X
ERIGE	Erigeron spp. (Other)		X	
ERFL	E. flagellaris			X
ERSP	E. speciosus	0-10	10+	
ERIOG	Eriogonum spp. (sage-grass type)	0-5	6-10	10+
	E. spp. (General)	0-10	10+	
ERLA	Eriophyllum lanatum		X	
ERCI	Erodium cicutarium		X	
ERYSI	Erysimum spp.	X		
ERYTH	Erythronium spp.		X	
*ESCHS	Eschscholtzia spp.		X	
EUPHO	Euphorbia spp.		X	
FRAGA	Fragaria spp.		X	
FRMO2	Frasera montana		X	
FRSP	F. speciosa		X	
FRITI	Fritillaria spp.	X		
GALIU	Galium spp. (Other)			X
GABO	B. boreale		X	
GENTI	Gentiana spp.		0-10	10+
GERAN	Geranium spp.	0-5	6-25	25+
GEMA	Geum macrophyllum		X	
GETR	G. triflorum	X		

Toiyabe N.F. -

RANGE ENVIRONMENTAL ANALYSIS HANDBOOK

*-Exhibit 41-H--Continued

Symbol		Desirable	Intermediate	Least Desirable
	FORBS			
LITHO	Lithophragma spp.		X	
LIRU	Lithospermum ruderale		X	
LOMAT	Lomatium spp. (Other)		X	
LODI	L. dissectum		0-10	10+
LONU	L. nuttallii		0-10	10+
LOTR	L. triternatum	X		
LOTUS	Lotus spp.		X	
LUPIN	Lupinus spp. (Other)	0-5	6-20	20+
LUKI	L. kingii			X
LYSP	Lygodesmia spinosa		X	
MACHA	Machaeranthera spp.		X	
MAGL	Madia glomerata			X
MANE	Malva neglecta			X
MAVU	Marrubium vulgare			X
MEDIC	Medicago spp. (Other)		X	
MESA	M. sativa	X		
MELIL	Melilotis spp.	0-10	11-30	30+
MENTH	Mentha spp.		X	
MENTZ	Mentzelia spp.		X	
MERTE	Mertensia spp. (Other)	0-20	21-40	40+
MEARL	M. arizonica leonardi	0-20	21-40	40+
MEBR	M. brevistyla	X		
MECI	M. ciliata	0-20	21-40	40+
MIMUL	Mimulus spp.		X	
MONAR	Monarda spp.	X		
MOOD	Monardella odoratissima		X	
MUDI	Musineon divaricatum		X	
NEMOP	Nemophila spp.			X
OENOT	Oenothera spp.		X	
ORTHO	Orthocarpus spp.			X
OSCH	Osmorhiza chilensis		X	
OSDE	O. depauperata		X	
OSOC	O. occidentalis (General)	0-20	21-40	40+
	O. occidentalis (6-CAGE)	0-10	11-30	30+
OXYTR	Oxytropis spp.		X	

RANGE ENVIRONMENTAL ANALYSIS HANDBOOK

*-Exhibit 41-H--Continued

Symbol		Desirable	Intermediate	Least Desirable
	FORBS			
GILIA	Gilia spp. (Other)		X	
GICO	G. congesta			X
GRIND	Grindelia spp.			X
HACKE	Hackelia spp.		X	
HAFL	H. floribunda	0-5	5+	
HAGL	Halogeton glomeratus			X
HAPLO	Haplopappus spp.		X	
HEDYS	Hedysarum spp.	X		
HEHO	Helenium hoopesii			X
HEUN	Helianthella uniflora	0-10	10+	
HELI2	Helianthus spp.		X	
HELA	Heracleum lanatum	X		
HEUCH	Heuchera spp.	X		
HIERA	Hieracium spp.	X		
HOFU	Horkelia fusca		X	
HYCA	Hydrophyllum capitatum		0-5	
HYFI	Hymenopappus filifolius		X	
HYME3	Hymenoxys spp.		X	
HYRI	H. richardsonii			X
HYFO	Hypericum formosum			X
ILRI	Iliamna rivularis		X	
IRMI	Iris missouriensis		0-10	10+
IVAX	Iva axillaris			X
IVESI	Ivesia spp.		X	
LACTU	Lactuca spp.			X
LAPPU	Lappula spp.		X	
LATHY	Lathyrus spp.	0-10	11-30	30+
LAUT	L. utahensis	X		
LEPID	Lepidium spp.			X
LESQU	Lesquerella spp.			X
LEWIS	Lewisia spp.		X	
LIGUS	Ligusticum spp.	X		
LIFI	L. filicinum	0-10	11-30	30+
LIPO	L. porteri	0-10	11-30	30+
LINU	Linanthastrum nuttallii			X
LIKI	Linum kingii		X	
LILE	L. lewisii	X		

RANGE ENVIRONMENTAL ANALYSIS HANDBOOK

*-Exhibit 41-H--Continued

Symbol		Desirable	Intermediate	Least Desirable
	FORBS			
PABR	Paeonia brownii	X		
PEDIC	Pedicularis spp.		X	
PENST	Penstemon spp. (Other)	0-5	5+	
PEAT3	P. attenuatus		0-10	10+
PERY	P. rydbergii		0-10	10+
PEPU2	Petradoria pumila			X
PHACE	Phacelia spp.		X	
PHLOX	Phlox spp.(Low sagebrush)		0-10	10+
	P. spp. (General)		X	
PHYS2	Physaria spp.		X	
PLANT	Plantago spp.			X
POLEM	Polemonium spp.	0-5	6-30	30+
POLY3	Polygonum spp. (Other)			X
POBI	P. bistortoides	0-5	6-30	30+
POPH	P. phytolaccaefolium		0-10	10+
POTEN	Potentilla spp. (General)		X	
	P. spp. (Meadow)		0-10	10+
POBR	P. brevifolia	0-5	5+	
PODI2	P. diversifolia	0-5	5+	
POGL	P. glandulosa		0-10	10+
POGRP	P. gracilis pulcherrima	0-5	5+	
PSMO	Pseudocymopterus montanus		X	
PTAQ	Pteridium aquilinum			X
RANUN	Ranunculus spp. (Other)		X	
RATE	R. testiculatus			X
RUOC	Rudbeckia occidentalis		0-10	10+
RUMEX	Rumex spp.		0-5	5+
SAKAT	Salsola kali tenuifolia			X
SAXIF	Saxifraga spp.		X	
SCROP	Scrophularia spp.		X	
SEDUM	Sedum spp.		X	
SENEC	Senecio spp. (General)			X
	S. spp. (Meadow)		0-5	5+
SEIN	S. integerrimus			X
SESE	S. serra	0-5	6-30	30+
SETR	S. triangularis	0-10	10+	

*-Exhibit 41-H--Continued

Symbol		Desirable	Intermediate	Least Desirable
	FORBS			
SIDAL	Sidalcea spp.	X		
SISYM	Sisymbrium spp.			X
SISYR	Sisyrinchium spp.		X	
SMILA	Smilacina spp.		X	
SOLID	Solidago spp.		X	
SPHAE	Sphaeralcea spp.		X	
STJA	Stellaria jamesiana			X
TAOF	Taraxacum officinale		0-10	10+
THFE	Thalictrum fendleri	0-10	10+	
THMO	Thermospis montana	0-5	6-20	20+
TRAGO	Tragopogon spp.			X
TRIFO	Trifolium spp.	0-5	5+	
URTIC	Urtica spp.		0-10	10+
VAED	Valeriana edulis		X	
VAOC	V. occidentalis	X		
VECA	Veratrum californicum	0-10	10+	
VERBA	Verbascum spp.			X
VEBI	Veronica biloba			X
VICIA	Vicia spp.	X		
VIMU	Viguiera multiflora		X	
VIOLA	Viola spp.		X	
VINU	V. nuttallii		0-10	10+
WYAM	Wyethia amplexicaulis		0-10	10+
WYHE	W. helianthoides		0-10	10+
ZIGAD	Zigadenus spp. (General)		X	
	Z. spp. (Meadow)			X
	SHRUBS			
ACER	Acer spp.	0-10	11-25	25+
AMAL	Amelanchier alnifolia	0-10	10+	
AMUT	A. utahensis	0-10	10+	
ARCT2	Arctostaphylos spp.		X	
ARPA	A. patula		0-50	50+

RANGE ENVIRONMENTAL ANALYSIS HANDBOOK

*-Exhibit 41-H--Continued

Symbol		Desirable	Intermediate	Least Desirable
	SHRUBS			
ARARA	Artemisia arbuscula (ARARA Type)	0-30	31-70	70+
	A. arbuscula (General)		0-25	25+
ARAN	A. " nova	0-50	51-80	80+
ARCAC	A. cana cana		0-10	10+
ARFR	A. frigida	0-5	6-20	20+
ARTR	A. tridentata		0-10	10+
ARTR2	A. tripartita		0-10	10+
ATCA	Atriplex canescens	X		
ATCO	A. confertifolia	0-5	6-20	20+
BEFR	Berberis fremontii		0-30	30+
BERE	B. repens		0-20	20+
CEANO	Ceanothus spp.	0-10	10+	
CEFE	C. fendleri	X		
CEGR	C. greggii	X		
CESA	C. sanguineus	X		
CEVE	C. velutinus	0-10	11-25	25+
CEOC2	Cercis occidentalis		X	
CELEL	Cercocarpus ledifolius ledifolius	0-30	30+	
CELE2	C. ledifolius intricatus	X		
CEMO	C. montanus	0-30	30+	
CHMI	Chamaebatiaria millefolium		X	
CHLI	Chilopsis linearis		X	
CHUM	Chimaphila umbellata		X	
CHNA	Chrysothamnus nauseosus		0-10	10+
CHVIL	C. viscidiflorus lanceolatus	0-5	6-20	20+
CORA2	Coleogyne ramosissima		0-30	30+
CORNU	Cornus spp.	X		
COMES	Cowania mexicana stansburiana	X		
ELCO2	Elaeagnus commutata		X	
EPHED	Ephedra spp.		X	
ERAN	Eriodictyon angustifolium			X
ERIO2	Eriogonum spp.		X	
EUROT	Eurotia spp.	X		

RANGE ENVIRONMENTAL ANALYSIS HANDBOOK

*-Exhibit 41-H--Continued

Symbol		Desirable	Intermediate	Least Desirable
	SHRUBS			
FAPA	Fallugia paradoxa		X	
FRDU	Franseria dumosa		X	
FRAN	Fraxinus anomala	X		
GARRY	Garrya spp.	0-10	11-20	20+
GLOSS	Glossopetalon spp.	X		
GRAYI	Grayia spp.		X	
GUSA	Gutierrezia sarothrae			X
HAMA	Haplopappus macronema		0-20	20+
HODU	Holodiscus dumosus		X	
JUCOS	Juniperus communis saxatilis		0-10	10+
JUOS	J. osteosperma		0-10	10+
JUSC	J. scopulorum		X	
KAPO	Kalmia polifolia	X		
KRPA	Krameria parvifolia		X	
LADI	Larrea divaricata		0-20	20+
LEGL	Ledum glandulosum	X		
LEPU	Leptodactylon pungens		X	
LOIN	Lonicera involucrata	X		
LOUT	L. utahensis	X		
LYCIU	Lycium spp.		X	
OPUNT	Opuntia spp.		0-10	10+
OPFR	O. fragilis		0-25	25+
PAMY	Pachistima myrsinites	0-10	11-25	25+
PENS2	Penstemon spp.		X	
PEFR3	P. fruticosus	0-10	10+	
PERA	Peraphyllum ramosissimum	0-10	11-25	25+
PHLE	Philadelphus lewisii	X		
PHEM	Phyllodoce empetriformis	X		
PHMA	Physocarpus malvaceus		0-30	30+
POPUL	Populus spp.	0-10	10+	
POTR	P. tremuloides	0-10	10+	
POFR	Potentilla fruticosa		0-10	10+

*-Exhibit 41-H--Continued

Symbol		Desirable	Intermediate	Least Desirable
	SHRUBS			
PRJUT	Prosopis juliflora torreyana		0-10	10+
PREM	Prunus emarginata	0-10	11-20	20+
PRFA	P. fasciculata	X		
PRVI	P. virginiana	0-10	11-20	20+
PUTR	Purshia tridentata	X		
QUGA	Quercus gambelii	0-15	16-25	25+
QUTU	Q. turbinella	0-10	11-20	20+
RHAL	Rhamus alnifolia		X	
RHBE O	R. betulaefolia obovata		X	
RHPU	R. purshiana		X	
RHGL	Rhus glabra		X	
RHTR	R. trilobata		0-10	10+
RIBES	Ribes spp.		X	
RICEI	R. cereum inebrians		X	
RIMO	R. montigenum	0-10	10+	
ROSA	Rosa spp.		X	
RUBUS	Rubus spp.	X		
SALIX	Salix spp. (General)	0-10	11-40	40+
	Salix spp. (Salix community)	0-50	50+	
SADOC	Salvia dorrii carnosa		X	
SACE	Sambucus cerulea	X		
SARP2	S. racemosa pubens mycrobotrys	0-10	11-25	25+
SAVE	Sarcobatus vermiculatus		0-20	20+
SHEPH	Shepherdia spp.	0-10	10+	
SOSC	Sorbus scopulina		X	
SPIRA	Spiraea spp.		X	
SYMPH	Symphoricarpos spp.	0-10	11-25	25+
TECA	Tetradymia canescens		X	
VACCI	Vaccinium spp.	X		
VASC	V. scoparium	0-5	5+	

RANGE ENVIRONMENTAL ANALYSIS HANDBOOK

*-Exhibit 41-I

Species List

Alpine

Symbol		Desirable	Intermediate	Least Desirable
	GRASSES AND GRASSLIKE			
AGSC	Agropyron scribneri	0-5	5+	
AGTR	A. trachycaulum	X		
AGSC2	Agrostis scabra		X	
AGVA	A. variabilis	X		
ALOPE	Alopecurus spp.	X		
CAPU	Calamagrostis purpurascens	X		
CARUD	Carex rupestris drummondiana (General)	0-25	25+	
	C. " " (Grass-sedge community)	0-10	10+	
CAPH	C. phaeocephala		X	
CAPS	C. pseudoscirpoidea	0-15	15+	
CATO	C. tolmiei	0-15	15+	
CAREX	C. spp. (Other)	X		
DAIN	Danthonia intermedia	X		
DECA	Deschampsia caespitosa	X		
ELEOC	Eleocharis spp.	0-10	10+	
ERIOP	Eriophorum spp.	X		
FEOVB	Festuca ovina brachyphylla	X		
HEMO	Helictotrichon mortonianum	X		
JUDR	Juncus drummondii		0-15	15+
JUPA	J. parryi		0-15	15+
JUNCU	J. spp. (Other)	X		
KOMY	Kobresia myosuroides	X		
LUSP2	Luzula spicata	X		
PHAL	Phleum alpinum	X		
POAL	Poa alpina	0-5	5+	

RANGE ENVIRONMENTAL ANALYSIS HANDBOOK

*-Exhibit 41-1--Continued

Symbol		Desirable	Intermediate	Least Desirable
	GRASSES AND GRASSLIKE			
POSE	Poa secunda		X	
POA	P. spp. (Other)	X		
TRSP	Trisetum spicatum	X		
	FORBS			
ACMIL	Achillea millefolium lanulosa (General)		0-5	5+
	A. m. lanulosa (Meadow)			X
AGOSE	Agoseris spp.		0-5	5+
ANSE	Androsace septentrionalis (General)			X
	A. s. (Early succession)		X	
ANNFO	Annuals (Other)			X
ANTEN	Antennaria spp.		0-5	5+
ARENA	Arenaria spp. (General)		X	
	A. spp. (Pulvinate community)	X		
ARNIC	Arnica spp.		X	
ARNOS	Artemisia norvegica saxatilis	X		
ARSC2	A. scopulorum	X		
ASTER	Aster spp. (General)		X	
	A. spp. (Meadow)			X
CALE	Caltha leptosepala	0-10	10+	
CAUN	Campanula uniflora	X		
CASTI	Castilleja spp.	X		
DRABA	Draba spp.		X	
ERIGE	Erigeron spp. (General)		X	
	E. spp. (Meadow)			X
ERITR	Eritrichium spp. (General)		X	
	E. spp. (Early succession)	X		
GENTI	Gentiana spp.	X		
GERO	Geum rossii (GERO community)	0-50	50+	
	G. " (Forb-grass community)	0-25	26-60	60+

*-Exhibit 41-1--Continued

Symbol		Desirable	Intermediate	Least Desirable
	FORBS			
GERO	Geum rossii (KOMY and grass-sedge community)	0-15	16-40	40+
	G. " (Meadow community)		0-20	20+
	G. " (Other community)		X	
HYAC	Hymenoxys acaulis		X	
HYGR	H. grandiflora		X	
HYME3	H. spp. (Other)			X
IVGO	Ivesia gordonii		0-10	10+
LEPY	Lewisia pygmaea		X	
LLSE	Lloydia serotina		X	
LOHE	Lomatium hendersonii	X		
LYCHN	Lychnis spp.		X	
MECI	Mertensia ciliata	X		
PAPU	Paronychia pulvinata (Pulvinate and CARUD community)	X		
	P. pulvinata (Grass-sedge comm.)			X
PEBR	Pedicularis bracteosa		X	
PEGR	P. groenlandica	X		
PEMO3	Penstemon montanus		X	
PLANT	Plantago spp.			X
POEA	Podistera eastwoodiae	X		
POLEM	Polemonium spp.		X	
POBI	Polygonum bistortoides	0-5	6-15	15+
POVI2	P. vivipar um		X	
POTEN	Potentilla spp. (General)		X	
	P. spp. (Meadow)		0-10	10+
RANUN	Ranunculus spp.		X	
SARH	Saxifraga rhomboidea		X	
SERH	Sedum rhodanthum		X	
SEST	S. stenopetalum			X
SELAG	Selaginella spp. (General)	X		
	S. spp. (Meadow)		X	
	S. spp. (Sedge-grass community)		X	

*-Exhibit 41-1--Continued

Symbol		Desirable	Intermediate	Least Desirable
SECR	Senecio crassulus		X	
SENEC	S. spp. (General)		0-10	10+
	S. spp. (Meadow)			X
SIPR	Sibbaldia procumbens		X	
SIAC	Silene acaulis (Pulvinate and CARUD community)	X		
	S. " (Other community)		X	
SMCA	Smelowskia calycina		X	
SOLID	Solidago spp.		X	
TALY	Taraxacum lyratum			X
TAOF	T. officinale			X
TRIFO	Trifolium spp. (General)	0-10	10+	
	T. spp. (Meadow)		X	
	T. spp. (Cushion plant community)	X		
	BROWSE			
BEGL	Betula glandulosa	X		
DROC	Dryas octopetala	X		
KAPO	Kalmia polifolia	X		
POFR	Potentilla fruticosa		0-20	20+
RIMO	Ribes montigenum	0-10	10+	
SALIX	Salix spp.	0-30	31-50	50+
VAOC2	Vaccinium occidentale	0-30	30+	
VACA	V. caespitosum		X	

-*

***-Exhibit 41- J**

GUIDE FOR RATING VEGETAL CONDITION

A. *Composition* — *Points*

1. *Desirable Species Dominant* 49-60

Range is in pristine or near pristine condition; the stand is made up mostly of desirable species with none or a negligible amount of least desirables. The community is generally rich in species.

2. *Desirable and Intermediate Species Mixed* 37-48

Desirables and intermediates make up most of the stand but with the desirables maintaining the greater percentage. Least desirables unimportant.

3. *Intermediate Species Dominant* 25-36

Intermediate species characterize the stand with a good percentage either or both desirables and least desirables. There is often a loss of species to the stand.

4. *Intermediate and/or Least Desirable Generally Dominant* 13-24

Desirable species make up a minority of the stand. One or two intermediates or least desirable species dominant.

5. *Least Desirable Species Dominant* 0-12

Intermediates may be important in some stands. Desirables are generally unimportant. One or two least desirable species are generally dominant.

B. *Production* (as indicator of vigor and vegetal cover)

1. Production of desirable and intermediate plants 81 to 100 percent of the site potential — yearly fluctuation in production considered 33-40
2. Production 61 to 80 percent of potential 25-32
3. Production 41 to 60 percent of potential 17-24
4. Production 21 to 40 percent of potential 9-16
5. Production 20 percent or less of potential ..... 0-8 -*

Exhibit 41 - J 1

GRAPHIC GUIDE FOR RATING VEGETAL CONDITION

Composition Triangle

To determine composition rating:

1. Compute percentage of desirable and intermediate plants on ocular or site analysis forms.
2. Locate percent intermediates on bottom scale and desirables on left scale.
3. Point of interception of the two lines gives the composition point rating.

Desirables	Intermediates-*																				
	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
100													60								
95												55	60								
90											50	55	60								
85										47	50	54	56								
80									45	46	48	50	53								
75								42	43	44	46	49	50								
70							39	40	41	42	44	46	47								
65						35	36	37	38	39	41	43	44								
60					31	32	33	34	35	36	38	40	41								
55				27	28	29	30	31	32	33	35	38	39								
50			24	25	25	26	27	28	29	31	33	36	37								
45		20	21	21	22	23	24	25	27	29	31	33	35								
40		17	17	18	18	19	20	21	23	25	27	29	31	34							
35		14	14	15	15	16	16	18	19	21	23	25	27	30	33						
30		12	12	13	13	14	14	15	16	18	20	22	23	26	29	32					
25		10	10	11	11	12	12	13	15	16	18	19	21	23	25	28	32				
20		8	8	9	9	10	11	12	14	15	17	18	20	21	23	25	28	31			
15		6	6	7	7	8	10	11	13	14	16	17	19	20	22	23	25	28	31		
10		4	4	5	6	7	9	10	12	13	15	16	18	19	21	22	24	26	28	30	
5		2	3	4	5	6	8	9	11	12	14	15	17	18	20	21	23	24	26	28	30
0	0	0	1	2	4	5	7	8	10	11	13	14	16	17	19	20	22	23	25	26	28	30

Production Chart

% of site potential D&I plants	Production rating
100	40
95	38
90	36
85	34
80	32
75	30
70	28
65	26
60	24
55	22
50	20
45	18
40	16
35	14
30	12
25	10
20	8
15	6
10	4
5	2

RANGE ENVIRONMENTAL ANALYSIS HANDBOOK

*-Exhibit 41- K

PART I - GUIDE FOR RATING SOIL CONDITION
(For All Types Except Alpine)

Ground Cover Index

		Points
1.	Ground cover (basal area of herbaceous plants, moss and lichens, litter, and pavement and rock over 3/4 in. diameter 1/) is between 91 to 100 percent. Dispersion rating 2/ uniform.	41-50
2.	Ground cover is between 76 to 90 percent. Dispersion rating uniform.	31-40
3.	Ground cover between 61 to 75 percent. Dispersion rating fairly uniform or above.	21-30
4.	Ground cover between 31 to 60 percent. Dispersion rating variable or above.	11-20
5.	Ground cover between 0 to 30 percent. Dispersion rating highly variable or above.	0-10

1/ Stone fragments 1/8 in. to 3/4 in. diameter which form a mat of effective cover may also be tallied as ground cover.

2/ If the dispersion rating for a site is below that shown in the ground cover index class for the site, the ground cover index rating will be dropped five (5) points for each dispersion rating below that indicated in the appropriate ground cover index.

COVER DISPERSION INDEX

A measure of cover dispersion can be obtained by calculating the spread between the second highest and the second lowest percent of bare ground in each 10-plot transect.

Based on this dispersion, the site will be classified as follows:

Difference between second highest and second lowest plots	Cover Dispersion Classification
(a) 0-25%	Uniform
(b) 26-50%	Fairly Uniform
(c) 51-75%	Variable
(d) 76% and over	Highly Variable-*

*- PART II — GUIDE FOR RATING SOIL CONDITION
(For All Types Except Alpine)

Current Soil Erosion

Points

1. *No evidence of soil movement:* 41-50

   Plant and litter cover adequate for soil protection and well dispersed; rock and pavement where present normal and in place (may have surface covered with lichens); gullies, if present, completely stabilized and healed.

2. *Soil movement slight and local:* 31-40

   Isolated bare soil openings characterize this stage. Erosion is confined more or less to the individual bare soil opening. Indicators may include:

   a. Wind scouring when soil is dry (particularly after trampling by livestock).

   b. Rills are lacking except in the larger interspaces after heavy storm.

   c. Some erosion pavement may occur in interspaces on gravelly soils.

3. *Soil movement moderate:* 21-30

   Bare soil openings larger and frequently joined together. Earmarks of active erosion may include one or more of the following indicators:

   a. Soil hummocking due to lowering of the soil surface in the bare areas.

   b. Pedestalling of plants.

   c. Erosion pavement evident in gravelly soils.

   d. Rills conspicuous after storms.

   e. Gullies occasional and moderately active (cutting after heavy storms).

   f. Sheet erosion has removed less than half of the "A" horizon.

   g. Some noticeable alluvial deposition. -*

*- 4. *Soil movement advanced:* 11-20

Bare ground dominates the site. Advanced erosion is characterized by one or several of the following indicators:

a. Soil loss heavy and continuing with subsoil exposed in places, at least half of the "A" horizon having been lost.

b. Where soils are gravelly, heavy erosion pavement occurs.

c. Gullies frequent and active.

d. Plants pedestalled or partially buried due to dislodging and redeposition of the soil.

e. Wind scouring on exposed sites.

f. Exposure of root crowns and roots of shrubs.

5. *Soil movement severe:* 0-10

Most of the area bare and uninfluenced by vegetation or litter. One or several of the following indicators will be present under severe erosion:

a. Subsoils largely exposed.

b. Heavy pavement on gravelly soils.

c. Bedrock exposed on "A - C" soils (young, poorly developed soils).

d. Gullies frequent and deep and actively cutting with each storm.

e. Large soil deposits. -*

RANGE ENVIRONMENTAL ANALYSIS HANDBOOK

*-Exhibit 41- L

PART I - GUIDE FOR RATING SOIL CONDITION
(For Alpine Types)

Ground Cover Index

		Points
1.	Ground cover (basal area of herbaceous plants, moss and lichens, litter, and pavement and rock over 3/4 in. diameter 1/)is between 96 to 100 percent. Dispersion rating 2/ uniform.	41-50
2.	Ground cover is between 91 to 95 percent. Dispersion rating uniform.	31-40
3.	Ground cover between 81 to 90 percent. Dispersion rating fairly uniform or above.	21-30
4.	Ground cover between 66 to 80 percent. Dispersion rating variable or above.	11-20
5.	Ground cover less than 65 percent. Dispersion rating highly variable or above.	0-10

1/ Stone fragments 1/8 in. to 3/4 in. diameter which form a mat of effective cover may also be tallied as ground cover.

2/ If the dispersion rating for a site is below that shown in the ground cover index class for the site, the ground cover index rating will be dropped five (5) points for each dispersion rating below that indicated in the appropriate ground cover index.

COVER DISPERSION INDEX

A measure of cover dispersion can be obtained by calculating the spread between the second highest and the second lowest percent of bare ground in each 10-plot transect.

Based on this dispersion, the site will be classified as follows:

Difference between second highest and second lowest plots	Cover Dispersion Classification
(a) 0-25%	Uniform
(b) 26-50%	Fairly Uniform
(c) 51-75%	Variable
(d) 76% and over	Highly Variable-*

*- PART II — GUIDE FOR RATING SOIL STABILITY (For Alpine Types)

Current Soil Erosion

Points

1. *There is no evidence of soil movement:* 41-50

Plant and litter cover is adequate for soil protection and well dispersed. Rock and pavement where present are natural and are in place (lichens are generally conspicuous on natural rock and pavement). There may be a few natural breaks due to natural climatic and topographic conditions.

Points

2. *Soil movement is slight and local:* 31-40

Isolated bare soil openings or sod breaks characterize this stage. Individually, these bare soil openings do not exceed 4 inches in diameter. Erosion is generally confined to the individual bare soil openings. Once the sod is broken, both wind and surface water enlarge and extend the breaks until subsurface rock material begins to show up.

3. *Soil movement is moderate:* 21-30

Bare soil openings (sod breaks) are larger and are frequently joined together. Bare soil openings from 4 inches to 18 inches in extent are present. Earmarks of erosion are:

a. Cupping out of the bare areas and exposure of rock and erosion pavement.

b. Some soil hummocks and plant pedestals.

c. Watercourses cutting.

d. There may be light scalping on slopes.

e. Soil and gravel depositions accompany channel cutting. -*

*4. *Soil movement heavy:* 11-20

Heavy erosion is characterized by numerous and continuous soil breaks with the vegetation presenting a patchy appearance. Bare soil openings are generally from 18 inches to 6 feet in diameter. Some indicators that may be evident are:

a. Deep cupping out of the bare areas by wind and water on more level areas.

b. Exposure of rock and pavement.

c. Extensive raw banks and cutting in drainageways especially on slopes above 5 percent.

d. Considerable soil hummocking and plant pedestalling.

e. Terracing of slopes.

f. Moderate to heavy scalping on slopes.

g. Deposition of erosion material.

5. *Soil movement severe:* 0-10

The bulk of the bare soil openings is over 6 feet in diameter and many of them join in a nearly continuous mass of bare ground. Topsoil has been lost or is being lost from half or more of the area. Indicators of soil loss are the same as under No. 4 except they are at a greater accelerated rate.-*

*-Exhibit 41.- M

APPARENT TREND

VEGETATION

Up or Stable	Down
1. Desirable frequency groupings and age classes of desirables, intermediates and least desirables.	1. A disproportionate amount of intermediates and least desirables. Seedlings of better plants having difficulty in becoming established. .....
2. Forage plants not being pulled up or trampled out by grazing.	2. Forage species being pulled up and trampled out by grazing. .....
3. Vigor of key species high as indicated by leaf length, seed stock production and normal color.	3. Low vigor of key species as indicated by reduced size of plant, leaf length of seed stalks, and off color (sickly yellow). .....
4. Browse species showing no hedging.	4. Browse species showing moderate to heavy hedging. .....

SOIL

Up or Stable	Down
1. Ground cover dispersion — uniform.	1. Ground cover dispersion — variable to highly variable. .....
2. No detectable soil movement.	2. Soil movement detectable. .....
3. Soil surface continuous and intact.	3. Cupping out between soil remnants. .....
4. No exposure of plant roots.	4. Plant roots exposed. .....
5. Stones and rock fragments, where present, normal and in place — no movement of rock fragments.	5. Stones and rock fragments, where present, concentrating on surface as erosion pavement. Fragments loose and often moving downslope. .....
6. Lichen lines on stones and rock fragments extend to soil level.	6. Lichen lines on stones considerably above soil surface — no lichens on rock fragments. .....
7. No active gullies.	7. Active gullies — indicated by recent cutting and sloughing. .....
8. No recent soil deposits either alluvial or aeolian.	8. Recent soil deposits — alluvial or aeolian. .....
9. No wind-scoured depressions.	9. Wind-scoured depressions. .....-*

R4-2200-25 (7/64)

RANGE ENVIRONMENTAL ANALYSIS HANDBOOK

*-Exhibit 41-N

SITE ANALYSIS SUMMARY

WRITEUP NO.					PHOTO NO.
B10					DRW-4-89
FOREST	RANGER DISTRICT	ALLOTMENT	EXAMINER		DATE
07-PALISADE	04-WHITE RIVER	BALD MOUNTAIN	John Block		6/28/68
	PLOT SIZE / PLOT INTERVAL	TYPE DESIGNATION	KIND OF LIVESTOCK	SLOPE	EXPOSURE
	.96 / 1 ch.	U4 83/59 → ↓	CATTLE	35	NE
LOCATION ON THE SOUTH SIDE OF WILLOW CREEK NEAR THE FORKS.					ELEVATION 7500

	SPECIES	% DRY WT	GRAMS PER TRANSECT - GREEN WEIGHT TRANS 1	TRANS 2	TRANS 3	TOTAL	*GREEN WT./AC.	PROD. DRY WT. PER ACRE	% COMP	DESIRABILITY RATING D	I	L
GRASSES	FEID	55	51	90	75	216	720	396	34	30	4	
	AGSP	50	50	61	51	162	540	270	23	23		
	MEBU	55	7	9	17	33	110	60	5	5		
	STCO2	55	7			7	23	13	1	1		
	ELCI	45	2			2	7	3	T			
	POSE	65	11	8	6	25	83	54	5		5	
FORBS	ERIOG	35	51	15	11	77	259	91	7	5	2	
	VIOLA	35	1	2		3	10	4	T			
	ANNFO	45	1	1	T	2	7	3	T			
	LUPIN	25	64	66	T	130	433	108	9	5	4	
	AGOSE	45	2	T		2	7	3	T			
BROWSE	CRT											
	ARTR-G →	50	34	3	45	82	273	136	12		10	2
	CHVIL	50	5	4	10	19	63	32	3	3		
TOTALS			286	259	215	760	2535	1173	XXXX	72	25	2

% OVERSTORY (TREES)					
% OVERSTORY (SHRUB)	5	1	22	28	9
% CROWN COVER (HERB)					
% BARE GROUND	14	20	18	52	17
% PAV. (1/4" - 3/4" DIAM.)	12	9	14	35	12
% ROCK & PAV. (3/4" >)	3		9	12	4
% VEGETATION	27	30	19	76	25
% LITTER	44	41	40	125	42
AV. NO. CHIPS	4	2	3	9	.3
AV. NO. PELLET GROUPS	11	16	9	36	1.2

(100)

CONDITION RATING

COMPOSITION RATING 47

PRODUCTION RATING 36

FORAGE CONDITION RATING 83

GROUND COVER INDEX 27

CURRENT EROSION INDEX 32

SOIL CONDITION RATING 59

APPARENT TREND: VEG → SOIL ↓

BROWSE: CONDITION G

APPARENT TREND →

* CALCULATED BY FORMULA FOUND ON REVERSE OF THIS FORM

D&I PRODUCTION 1138 LBS. PER ACRE (DRY WT.)

EST. POTENTIAL PROD. FOR SITE 1275 LBS. PER ACRE (DRY WT.) -*

R4 2200.14 (11-68)

RANGE ENVIRONMENTAL ANALYSIS HANDBOOK

*-

SOIL SURFACE TEXTURE Sandy Loam ; THICKNESS 20" ; pH 6.5

SUBSOIL TEXTURE Heavy Sandy Loam ; THICKNESS 28" ; pH 6.3

% COURSE FRAGMENT CONTENT BY VOLUME: SURFACE 0 SUBSURFACE 10

SUBSTRATUM MATERIAL Highly Weathered Granitic ; EFFECTIVE ROOTING DEPTH 48"

REMARKS

EROSION PATTERN: SURFACE LOSSES AVERAGE 1 INCHES OVER 20 % OF THE AREA

GULLIES TOTAL APPROXIMATELY — FEET IN LENGTH AND AVERAGE ABOUT — FEET DEEP

REMARKS Although actual soil loss is not great, the surface is badly stirred in place under use.

INHERENT EROSION HAZARD: DETACHABILITY RATING 9 ; SURFACE COVERED WITH ROCK FRAGMENTS ¾ INCH OR GREATER IN DIAMETER 10 %; ADJUSTED DETACHABILITY RATING 8

PROFILE PERMEABILITY RATING 4 ; SOIL ERODIBILITY INDEX 32 ; CLASS III

SLOPE 35 %; INHERENT EROSION HAZARD, CLASS III

SOIL DISTURBANCE: COMPACTION None (NONE, LIGHT, MODERATE, HEAVY)

DISPLACEMENT Moderate (NONE, LIGHT, MODERATE, HEAVY)

COVER DISPERSION: UNIFORM ____ FAIRLY UNIFORM ✓ VARIABLE ____ HIGHLY VARIABLE ____

GROUND COVER PERCENT 71

GIVE REASONS FOR SUITABILITY CLASSIFICATION The area is about 2 miles from available water and is used only after excessive use is made of associated areas. On site soil displacement is excessive even under the very light use the area now receives and soil creep is continuing.

AIR-DRY CONTENT OF GREEN FORAGE

GRASSES & SEDGES	
JUST BEFORE HEADING	25 - 30 %
HEADED OUT	35 - 40 %
AFTER BLOOM	45 - 50 %
SEED MATURITY AND PAST	55 - 80 %
FORBS	
VERY LUSH	15 - 20 %
FLOWERING	20 - 25 %
SEED TIME	30 - 35 %
BROWSE	
LUSH LEAVES (SNOWBERRY)	30 - 40 %
FIBROUS LEAVES (OAK) & PURSHIA	35 - 45 %
RABBITBRUSH & SAGEBRUSH	40 - 60 %

FORMULA TO CONVERT GRAMS/TRANSECT TO #/ACRE

PLOT SIZE	NUMBER OF PLOTS 10	20	30
.96	X10	X5	X10/3
1.92	X5	X5/2	X5/3
4.8	X2	DIRECT	X2/3
9.6	DIRECT	÷ 2	÷ 3

ESTIMATED USE BASED ON DROPPINGS COUNT $.3 \times \frac{100}{12} = \frac{30}{12}$

CALCULATIONS $1.2 \times \frac{100}{13} = \frac{120}{13}$

CONVERSION FACTORS:
13 PELLET GROUPS PER SHEEP DAY
12 CHIPS PER COW DAY
PLOT SIZE 1/100 ACRE
A. 3.3 FT. ON EACH SIDE OF TRANSECT LINE
OR
B. SUPERIMPOSED CIRCULAR PLOT WITH AN 11.7 FT. RADIUS

$12\overline{)30.0}$ → 2.5, 24, 60, 60

$13\overline{)120.0}$ → 9.2, 117, 30, 26

FORMULA FOR A

$\frac{\text{DROPPINGS PER TRANSECT}}{\text{CHAINS PER TRANSECT}} \times \frac{100}{12} = \text{COW DAYS PER ACRE}$

FORMULA FOR B

$\text{AVERAGE DROPPINGS PER PLOT} \times \frac{100}{12} = \text{COW DAYS PER ACRE}$

COW DAYS PER ACRE 2.5

SHEEP DAYS PER ACRE

GAME DAYS PER ACRE D 9.2

E

M -*

RANGE ENVIRONMENTAL ANALYSIS HANDBOOK

*42 - OCULAR ANALYSIS

Ocular analysis is an alternative technique for gathering the same sort of information that is collected by the site analysis method. As the name implies, it is based, for the most part, on experienced observations rather than measurements. It may be used on no more than four of each five classifications to be analyzed on any given allotment. Its principal advantage is a more rapid collection of information.

In making an ocular analysis, the type to be analyzed is traversed and periodic stops are made to observe and note various site characteristics. Sufficient time must be spent in each situation to complete form R4-2200-10. Whenever a new situation is encountered such as a vegetal type, condition, or suitability class not recently analyzed, the observer will "retrain" his judgment by running a site analysis transect.

42.1 - Steps to Take in Running an Ocular Analysis.

In proceeding through a type, the examiner must be observant of the following characteristics so they can be summarized for the type as a whole: species present and their abundance, overstory and ground cover, browse condition and apparent trend, erosion patterns, soil disturbance, cover dispersion, and yield estimates. A worksheet or notes can be very useful for accumulating this information. In addition, the examiner will make dropping and pellet group counts on plots distributed through the type and will gather soil data from a site selected as representative of the type.

Upon completing his traverse of the type, the examiner will then compute the additional data needed to complete the form. He will complete his writeup while still in a representative portion of the area.

The encircled numbers on Exhibit 42-A refer to the following paragraphs:

1. List species. All species observed within the area being analyzed will be listed on form R4-2200-10 as "Grasses," "Forbs," or "Shrubs."

2. Percent Composition. An estimate on a dry weight basis will be made of the percentage each plant species makes of the total plant composition, except that a percentage need not be assigned to those that form less than one percent of the composition. Experience gained from making site analysis transects on similar types will be helpful.

A useful technique for estimating percent composition is to first estimate the percentages in grasses, forbs, and shrubs. Then estimate the relative abundance of species within each group starting with the most abundant and rating each less abundant species in turn. After percentages have been assigned, compare one species to another and adjust percentages until you are assured they are given proper relationship to each other.-*

*-3. Overstory and Ground Cover Determination. (See Sections 41.22 and 41.23.) Experience gained from running site analysis transects on similar types is the best guide for making these estimates.

4. Dropping Counts. (See Section 41.24.) Pellet group and chip counts will be made on 1/100th-acre plots. Plots one chain long and 6.6 feet wide can be used as the examiner moves from one observation point to another. Pellet groups will be shown as sheep (S), deer (D), elk (E), or moose (M).

5. Browse Condition and Trend. As a means of correlating livestock and game range analysis, the important browse species from the game management standpoint will be classified as to condition and apparent trend. (See Chapter 90, Section 93.3.)

6. Soil and Erosion Data. (See Section 41.25.) This part of the ocular analysis technique is identical to that for site analysis.

7. Soil Disturbance. (See Section 41.25.) The findings from site analysis transects should be used for guidance in this estimate.

8. Ground Cover Percent and Dispersion. (See Sections 41.23 and 41.26.) Experience gained from site analysis transects is the best guide for making these estimates.

9. Herbage Production. Production estimates of three kinds are made as follows:

a. Total Herbage Production. Total herbage production will be estimated on a dry weight basis. Experience gained from site analysis transects is the best guide for making this estimate. Production estimates should also be checked by periodic clippings and weighings.

b. Production of D&I Plants. This is a calculation of forage production based only upon Desirable and Intermediate plants. It is accomplished by adding the percentage of Desirable and Intermediate plants in the composition and multiplying this sum by the estimated total dry weight herbage production.

c. Estimated Potential Production. (See Section 41.28-4.)

10. Use Intensity Calculations. Using dropping counts and the formulas found on the back of the form, calculate days use per acre for each class of animal involved. Record the results in the indicated place on the lower right-hand corner of the back of the form. -*

*-11. Desirability Rating. (See Section 41.27.) Desirability rating column totals for grasses, forbs, and shrubs are added together and the resulting sums are recorded in the lower right-hand portion of the form face.

12. Condition Rating. (See Section 41.28.)

13. Apparent Trend. (See Section 41.28.)

14. Reasons for Suitability Classification. (See Section 41.29.)-*

RANGE ENVIRONMENTAL ANALYSIS HANDBOOK

*-Exhibit 42-A

OCULAR ANALYSIS

WRITEUP NO.				PHOTO NO.
S3				CVX-15-56
FOREST	RANGER DISTRICT	ALLOTMENT	EXAMINER	DATE
04-BANNOCK	03-STRAWBERRY	LAKE FORK	Wm. Smith	7/14/68
TYPE DESIGNATION	KIND OF LIVESTOCK	SLOPE	EXPOSURE	ELEVATION
S1 85/85 →	CATTLE	15	SW	8000

LOCATION IN PILOT PEAK BASIN SOUTH OF ROAD.

GRASSES	% COMP *	DESIRABILITY RATING D	I	L	FORBS	% COMP *	DESIRABILITY RATING D	I	L	SHRUBS	% COMP *	DESIRABILITY RATING D	I	L
ELCI	19	19			LUPIN	9	5	4		SYORO - P↓	3	3		
MEBU	4	4			BASA	4	4			CHVIL - F→	5	5		
FEID	3	3			CRAC	1	1			ARTR - F→	12		10	2
STCO2	2	2			WYAM	7		7		(1)	(2)		(11)	
BRMA	3	3			THFE	2	2							
PONE (1)	1	1			HAFL (1)	5	5							
AGSP (1)	2	2			AGUR (1)	3	3							
POSE	1		1		HEUN	6	6							
AGTR	T		(11)		GERAN	3	3							
	(2)				ASTER	3		3						
					VIOLA	1		1						
					DELPH (L)	1		1						
					AGOSE	T		(11)						
					TAOF	T								
					ERIOG	T								
					ANNFO	T								
						(2)								
TOTALS	35	34	1			45	29	16			20	8	10	2

- % OVERSTORY (TREES) ____
- % OVERSTORY (SHRUB) 5
- % CROWN COVER (HERBACEOUS) ____
- % BARE GROUND 5 (3)
- % PAV. (1/8" - 3/4" DIAMETER) 5
- % ROCK AND PAVEMENT (3/4" >) 0
- % VEGETATION 20
- % LITTER 70

100 %

COW CHIPS PER ACRE 150 (last year's) (4)

PELLET GROUPS PER ACRE S D E M
80

(5)

BROWSE: COND F APPARENT TREND →

% DESIRABLE	71
% INTERMEDIATE	27 (11)
% LEAST DESIRABLE	2
CONDITION RATING:	
COMPOSITION RATING	47
PRODUCTION RATING	38
FORAGE CONDITION RATING	85
GROUND COVER INDEX	40 (12)
CURRENT EROSION INDEX	45
SOIL CONDITION RATING	85

APPARENT TREND: VEG. → SOIL →

(13)

ON BASIS OF DRY WEIGHT ESTIMATES. -

RANGE ENVIRONMENTAL ANALYSIS HANDBOOK

*-SOIL: SURFACE TEXTURE Loam, THICKNESS 12", pH 6.0
SUBSOIL TEXTURE Clay Loam, THICKNESS 24"+, pH 6.5

% COURSE FRAGMENT CONTENT BY VOLUME: SURFACE 10 (6) SUBSURFACE 10
SUBSTRATUM MATERIAL Fractured Sandstone, EFFECTIVE ROOTING DEPTH 34"
REMARKS Cobble layer begins at 34".

EROSION PATTERN: SURFACE LOSSES AVERAGE – INCHES OVER – % OF THE AREA
GULLIES TOTAL APPROXIMATELY – FEET IN LENGTH AND AVERAGE ABOUT – FEET DEEP (6)
REMARKS No apparent erosion on this site.

INHERENT EROSION HAZARD: DETACHABILITY RATING 6; SURFACE COVERED WITH ROCK FRAGMENTS ¼ INCH OR GREATER IN DIAMETER 5 %; ADJUSTED DETACHABILITY RATING 6
PROFILE PERMEABILITY RATING 7; SOIL ERODIBILITY INDEX .42; CLASS IV (6)
SLOPE 15 %; INHERENT EROSION HAZARD, CLASS III

SOIL DISTURBANCE: COMPACTION None (7) (NONE, LIGHT, MODERATE, HEAVY)
DISPLACEMENT None (NONE, LIGHT, MODERATE, HEAVY)

COVER DISPERSION: UNIFORM ✓ FAIRLY UNIFORM (8) VARIABLE HIGHLY VARIABLE
GROUND COVER PERCENT 90

GIVE REASONS FOR SUITABILITY CLASSIFICATION Productive site on gently rolling topography. Slope less than ⅛ mile long and about ⅜ mile from permanent water. Soil well stabilized by vegetation and litter. Moderate inherent erosion hazard. (14)

AIR-DRY CONTENT OF GREEN FORAGE

GRASSES & SEDGES	
JUST BEFORE HEADING	25 - 30%
HEADED OUT	35 - 40%
AFTER BLOOM	45 - 50%
SEED MATURITY AND PAST	55 - 80%
FORBS	
VERY LUSH	15 - 20%
FLOWERING	20 - 25%
SEED TIME	30 - 35%
BROWSE	
LUSH LEAVES (SNOWBERRY)	30 - 40%
FIBROUS LEAVES (OAK) & PURSHIA	35 - 45%
RABBITBRUSH & SAGEBRUSH	40 - 60%

HERBAGE PRODUCTION ESTIMATES

ESTIMATED TOTAL HERBAGE PRODUCTION - LBS PER ACRE (DRY WT.) 1600
ESTIMATED TOTAL PRODUCTION - D AND I PLANTS LBS. PER ACRE (DRY WT.) 1565 (9)
ESTIMATED POTENTIAL PRODUCTION - LBS PER ACRE (DRY WT.) 1650

ESTIMATED USE BASED ON DROPPINGS COUNT

CONVERSION FACTORS:
13 PELLET GROUPS PER SHEEP DAY
12 CHIPS PER COW DAY
PLOT SIZE 1/100 ACRE
A. 3.3 FT. ON EACH SIDE OF TRANSECT LINE
OR
B. SUPERIMPOSED CIRCULAR PLOT WITH AN 11.7 FT. RADIUS

FORMULA FOR A

$$\frac{\text{DROPPINGS PER TRANSECT}}{\text{CHAINS PER TRANSECT}} \times \frac{100}{12} = \text{COW DAYS PER ACRE}$$

FORMULA FOR B

$$\text{AVERAGE DROPPINGS PER PLOT} \times \frac{100}{12} = \text{COW DAYS PER ACRE}$$

$12 \overline{)150.0}$ → 12.5; 12, 30, 24, 60

CALCULATIONS

$13 \overline{)80.0}$ → 6.2; 78, 20

COW DAYS PER ACRE 12.5
SHEEP DAYS PER ACRE (10)
GAME DAYS PER ACRE D 6.2
E
M -*

*-March 1969
Amendment No. 4-*

Forest Service Handbook, R-4

Sugg. No. 436 (C...)

GREEN WEIGHT TO AIR DRY WEIGHT CONVERSION CHART

Species Total Pounds or Grams Green Weight

	% Air Dry Weight is of Green Weight																	
	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	
1					1	1	1	1	1	1	1	1	1	1	1	1	1	1
2				1	1	1	1	1	1	2	2	2	2	2	2	2	2	2
3		1	1	1	1	1	1	1	2	2	2	2	2	2	3	3	3	3
4	1	1	1	1	1	2	2	2	2	2	3	3	3	3	3	4	4	4
5	1	1	1	1	2	2	2	2	3	3	3	3	4	4	4	4	5	5
6	1	1	1	2	2	2	3	3	3	4	4	4	4	5	5	5	6	6
7	1	1	2	2	2	3	3	3	4	4	5	5	5	6	6	6	7	7
8	1	2	2	2	3	3	4	4	4	5	5	6	6	6	7	7	8	8
9	1	2	2	3	3	4	4	4	5	5	6	6	7	7	8	8	9	9
10	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8	9	9	10
11	2	2	3	3	4	4	5	5	6	7	7	8	8	9	9	10	10	11
12	2	2	3	4	4	5	5	6	7	7	8	8	9	10	10	11	11	12
13	2	3	3	4	5	5	6	6	7	8	8	9	10	10	11	12	12	13
14	2	3	3	4	5	6	6	7	8	8	9	10	10	11	12	13	13	14
15	2	3	4	4	5	6	7	7	8	9	10	10	11	12	13	13	14	15
16	2	3	4	5	6	6	7	8	9	10	10	11	12	13	13	14	15	16
17	3	3	4	5	6	7	8	8	9	10	11	12	13	14	14	15	16	17
18	3	4	4	5	6	7	8	9	10	11	12	13	13	14	15	16	17	18
19	3	4	5	6	7	8	9	9	10	11	12	13	14	15	16	17	18	19
20	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
21	3	4	5	6	7	8	9	10	12	13	14	15	16	17	18	19	20	21
22	3	4	5	6	7	8	9	10	11	12	13	14	15	16	18	19	20	21
23	3	5	6	7	8	9	10	11	13	14	15	16	17	18	20	21	22	23
24	4	5	6	7	8	10	11	12	13	14	16	17	18	19	20	22	23	24
25	4	5	6	7	9	10	11	12	14	15	16	17	19	20	21	22	24	25
26	4	5	6	8	9	10	12	13	14	16	17	18	19	21	22	23	25	26
27	4	5	7	8	9	11	12	13	15	16	18	19	20	22	23	24	26	27
28	4	6	7	8	10	11	13	14	15	17	18	20	21	22	24	25	27	28
29	4	6	7	9	10	12	13	14	16	17	19	20	22	23	25	26	28	29
30	4	6	7	9	10	12	13	15	16	18	19	21	22	24	25	27	28	30
31	5	6	8	9	11	12	14	15	17	19	20	22	23	25	26	28	29	31
32	5	6	8	10	11	13	14	16	18	19	21	22	24	26	27	29	30	32
33	5	7	8	10	12	13	15	16	18	20	21	23	25	26	28	30	31	33
34	5	7	8	10	12	14	15	17	19	20	22	24	25	27	29	31	32	34
35	5	7	9	10	12	14	16	17	19	21	23	24	26	28	30	31	33	35
36	5	7	9	11	13	14	16	18	20	22	23	25	27	29	31	32	34	36
37	6	7	9	11	13	15	17	18	20	22	24	26	28	30	31	33	35	37
38	6	8	9	11	13	15	17	19	21	23	25	27	28	30	32	34	36	38
39	6	8	10	12	14	16	18	19	21	23	25	27	29	31	33	35	37	39
40	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
41	6	8	10	12	14	16	18	20	23	25	27	29	31	33	35	37	39	41
42	6	8	10	13	15	17	19	21	23	25	27	29	31	34	36	38	40	42
43	6	9	11	13	15	17	19	21	24	26	28	30	32	34	37	39	41	43
44	7	9	11	13	15	18	20	22	24	26	29	31	33	35	37	40	42	44
45	7	9	11	13	16	18	20	22	25	27	29	31	34	36	38	40	43	45
46	7	9	11	14	16	18	21	23	25	28	30	32	34	37	39	41	44	46
47	7	9	12	14	16	19	21	23	26	28	31	33	35	38	40	42	45	47
48	7	10	12	14	17	19	22	24	26	29	31	34	36	38	41	43	46	48
49	7	10	12	15	17	20	22	24	27	29	32	34	37	39	42	44	47	49
50	7	10	12	15	17	20	22	25	27	30	32	35	37	40	42	45	47	50

RANGE ENVIRONMENTAL ANALYSIS HANDBOOK

*Exhibit 41-D

DRY WEIGHT CONVERSION TABLES

Grasses and Grasslike
Percent Airdry Weight

	STAGES OF DEVELOPMENT					
	Leaf	Boot	Bloom	Dough	Seed Maturity	Curing
Agropyron cristatum	27-30	35		50-55	56-62	
A. inerme		38	45		50-60	85-90
A. spicatum	30-35	36-40	40-45	45-55	50-65	66
A. subsecundum				45	50-60	
A. trachycaulum			35	37-45	50-60	
Arrhenatherum elatius			30-35			
Bromus inermis	30		30-40	30-40	35-40	
B. marginatus			30	35	40	
B. tectorum	25-30	30-35	35	40-50	60	92
Carex aquatilis				37	37	
C. geyeri	45	50	50	55	60	
C. rossii		40				
Elymus cinereus	30-40	35-40	45	50	60-70	
E. glaucus			30	40		
Eleocharis spp.					38	
Festuca idahoensis	25-30	31-35	40	45-50	50-60	
F. ovina	30	35	40	40-50	50-60	
F. thurberi				40-55	60	

*Exhibit 41-D--Continued

DRY WEIGHT CONVERSION TABLES

Grasses and Grasslike
Percent Airdry Weight

	STAGES OF DEVELOPMENT					
	Leaf	Boot	Bloom	Dough	Seed Maturity	Curing
Juncus spp.				33		
Melica bulbosa				45	50	
Poa fendleriana	30			35-50	40-50	
P. pratensis	25		27-34	35	45	
P. secunda	25-30	35	40-45	50	43	70-90
Sitanion hystrix	30	35		60	50-60	
Stipa columbiana			40-45	45-50		
S. comata				42		
S. lettermani			40	45-50	60	
S. thurberiana					65	
Wet meadow (all spp.)				26		

RANGE ENVIRONMENTAL ANALYSIS HANDBOOK

*-Exhibit 41-D--Continued

Forbs

Percent Airdry Weight

	STAGES OF DEVELOPMENT				
	Pre-bloom	Bloom	Soft Seed	Seed Maturity	Curing
Achillea millefolium lanulosa	20-25	25	30	35	60
Actaea arguta	20				
Agastache urticifolia	25	30			
Agoseris spp.	17				
Artemisia ludoviciana				36	
Aster spp.	25	35	40	45-50	70
A. adscendens				34	
A. foliaceus			30	34	
A. scopulorum				50	
Balsamorhiza hookeri		25			50
B. sagittata	17-20	25-30	30-35	40-50	
Castilleja spp.	25	27	30-40	35-40	
C. linariaefolia				39	
Comandra pallida	35				
Crepis spp.	25	30	35	48	
Cordylanthus ramosus		30-35		50	
Delphinium occidentale	22	28			

RANGE ENVIRONMENTAL ANALYSIS HANDBOOK

*-Exhibit 41-D--Continued

Forbs

Percent Airdry Weight

	STAGES OF DEVELOPMENT				
	Pre-bloom	Bloom	Soft Seed	Seed Maturity	Curing
Erigeron spp.		25			
E. speciosus			33	35	55+
Eriogonum umbellatum		35-40	40-50	60-65	
Frasera speciosa		20	20		
Geranium spp.	20	25	25	25-30	
Hackelia floribunda			27		
Haplopappus parryi	20	22	30	35	
Helianthella uniflora	20				
Heracleum lanatum		20	20	20-25	
Hieracium albertinum				35	
Hymenoxys richardsoni		25	35		
Lathyrus spp.		25	30		50
L. leucanthus			30		
Ligusticum porteri			30		
Lithospermum ruderale		28			
Lomatium nuttallii			25	35	
Lotus wrightii		25			

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RANGE ENVIRONMENTAL ANALYSIS HANDBOOK

*-Exhibit 41-D--Continued

Forbs

Percent Airdry Weight

	STAGES OF DEVELOPMENT				
	Pre-bloom	Bloom	Soft Seed	Seed Maturity	Curing
Lupinus spp.	20-25	25-30	30-40	30	
L. sericeus		26			
L. argenteus		25-30	30-35	35-45	65
Lygodesmia spinosa	30				
Mertensia leonardi	18	20	22	22	
Microseris spp.	19				
Orthocarpus spp.					33
Osmorhiza occidentalis		21	25		
Penstemon spp.		25	28	35-50	
Petradoria pumila		50			
Potentilla spp.				38	
Phlox hoodii					70
Rudbeckia occidentalis	20-25	25			
Senecio integerrimus		15-20			
S. serra	20-25	25-30	35		
S. uintahensis			25		
Stellaria jamesiana	25		30	30	

RANGE ENVIRONMENTAL ANALYSIS HANDBOOK

*-Exhibit 41-D--Continued

Forbs

Percent Airdry Weight

	STAGES OF DEVELOPMENT				
	Pre-bloom	Bloom	Soft Seed	Seed Maturity	Curing
Thalictrum fendleri		30	35	40	
Valeriana occidentalis		20		25	
Vicia americana		25	30	30	
Viguiera multiflora		30	35		
Viola spp.	20				40
Wyethia amplexicaulis	25	30	35	40	

RANGE ENVIRONMENTAL ANALYSIS HANDBOOK

*-Exhibit 41-D--Continued

Shrubs

Percent Airdry Weight

	STAGES OF DEVELOPMENT				
	Early Leaf	Flowering	Mature Foliage	Late Season	Winter
Acer glabrum	30				
Amelanchier alnifolia		35-45	40-50		
Artemisia arbuscula	35-40	45-55	50-55		
A. canescens			41		
A. frigida			47		
A. tridentata	35-40	40-45	50	60	60
Cercocarpus montanus		38			
Chrysothamnus viscidiflorus	25	40-45	55-60	60	
Gutierrezia sarathrae			45		
Pachistima myrsinites			45		
Opuntia fragilis	20				
Physocarpus malvaceus				75	
Prunus virginiana			45	70	
Purshia tridentata		40	40	55	
Quercus gambelii			40-50		
Rosa spp.		35	35		
Sambucus spp.			20-25		
Symphoricarpos spp.	25-30	35	40		
Tetradymia canescens			55	55-60	

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TABLES FOR CONVERTING GREEN WEIGHT TO DRY WEIGHT BY GROWTH STAGE

Green Weight x Percent = Dry Weight

GRASSES

Scientific Name	Common Name	Average Dry Matter Percent by Stages of Development: Pre-Bloom	Full Bloom	Dough Soft Seed	Seed Mature	Curing to Cured
GRASSES						
Agropyron spp.	Wheatgrasses	(27)	(45)	(50)	(60)	(85)
cristatum	Crested wheatgrass	25-30	40-45	50-55	60	75-90
elongatum	Tall	25	40-45	48-55	55-65	80-90
inerme	Beardless	25-30	35-40	45	50-60	80-90
intermedium	Intermediate	25	40-45	45-50	55-60	75-85
riparium	Streambank	25-30	45-50	53-56	60-65	80-90
dasystachyum	Thickspike	25	45-50	55-60	60-65	85-90
spicatum	Bluebunch	25-30	40-50	50-55	55-65	80-90
smithii	Western	25-30	45-50	53-58	60-65	70-90
subsecundum	Bearded	25	35-40	45-50	55-60	70-90
sibiricum	Siberian	25-30	40-45	50-55	60-65	75-90
trachycaulum	Slender	25-30	40-45	50-55	60-65	75-90
trichophorum	Pubescent	25-30	38-43	45-50	55-60	70-85
Arrenatherum elatius	Tall Oatgrass	25	35-40	40-45	50-55	65-85
Bromus spp.	Bromegrasses	20-25	35-40	40-48	50-55	75-85
inermis	Smooth (manchar)	20-25	35-40	40-45	50-55	75-85
marginatus	Mountain	20-25	35-45	40-45	50-60	65-85
tectorum	Cheat	25-30	35-40	50-55	60-65	85-90
Calamagrostis rubescens	Pinegrass	25-30	35-40	40-45	45-50	
Arristida longiseta	Red threeawn grass	28-35	40-45	50-55	60-65	85-90
Carex sp (dry)	Sedges	30-40	45-50	55	60	80
filifolia		30	45	55	60	80
geyeri	Elk	40	50	55	60	75
Dactylus glomeratus	Orchardgrass	20-25	30-35	40-45	50-55	60-80
Elymus spp.	Wild-ryegrass					
cinereus	Basin	25-30	45-50	50-55	60-65	65-80
glaucus	Blue	25	35-40	40	55	75-85
saline	Saline					
Eleocharis sp.	Rushes				38	
Festuca	Fesues					
elatior	Meadow-Alta-Tall	25	35-40	45-50	55-60	70
idahoensis	Idaho	30-35	40	45-50	50-60	75-85

NOTE: See last page for instructions.

Grasses (con't.)

Scientific Name	Common Name	Average Dry Matter Percent by Stages of Development: Pre-Bloom	Full Bloom	Dough Soft Seed	Seed Mature	Curing to Cured
ovina	Sheep	25-35	40-45	45-50	55-60	75-85
rubra	Red	25-30	40-45	45-50	55-60	70-85
Juncus spp.	Wiregrass	20	40-45	45-50		
Koeleria cristata	Junegrass	20-30	38-45	50-55	60-65	75-85
Melica bulbosa	Oniongrass	20-30	40-45	45-50	50-55	80-85
Oryzopsis hymenoides	Indian Rice grass	30	45-50	50-55	60-65	80
Oryzopsis webberi	Weber Rice grass	30	45	50	60-65	80
Poa						
ampla	Big	25-30	38-45	50-55	60-65	70+
nevadensis	Nevada	20-30	38-45	50-55	60-65	70+
pratensis	Kentucky	20-25	35-40	45-50	55-60	65-70+
secunda	Sandberg	25-30	40-45	50-55	55-60	85-90
Phalaris arundinacea	Reed Canary	25	40-45	50-55	60	75
Phleum pratense	Timothy	20-25	35-40	45-50		
Sitanion hystrix	Squirreltail	25-35	45-50	55-60	65-70	85-90
Sporobolus airoides	Alkali Sacaton	30	45	55	65	80
Sporobolus cryptandrus	Sand Dropseed	25	40	50	60	85
Stipa spp.	Needlegrasses					
columbiana	Columbia	25-30	40-45	50	55-60	75+
comata	Needle & Thread	25-30	40-45	50-55	60-65	70+
lettermani	Letterman	25-30	40-45	50-55	60-65	70+
thurberiana	Thurber	25-30	40-45	50-55	60-65	80+
Williamsi	Williams	25-30	40-45	50	55-60	70+

TABLES FOR CONVERTING GREEN WEIGHT TO DRY WEIGHT BY GROWTH STAGE

FORBS

Scientific Name	Common Name	Average Dry Matter Percent by Stages of Development: Pre-Bloom	Full Bloom	Dough Soft Seed	Seed Mature	Curing to Cured
FORBS						
Achillea lanulosa	Yarrow	17-20	27	30-39	40-45	60
Agastache urticifolia	Horsemint	25	30	45		
Agoseris spp.	Mt. Dandelion	17				
Allium spp.	Wild onion	15	20		40	70+
Artemisia ludoviciana	Green sage & cudweed	18			43-45	65+
Aster spp.	Aster	27	35	40	40-50	65+
Astragalus sp.	Tall			25		
Astragalus sp.	Low			25		
Balsamorhiza sagittata	Arrowleaf Balsamroot	17-25	30-35	35-45	45-50	65+
Castilleja spp.	Indian Paint Brush	25	27	30	35	50+
Crepis acuminata	Tapertip Hawksbeard	25	30	35	40	50
Crepis spp.	Hawksbeard	25	30	35	40	50
Delphinium spp.	Tall Larkspur	22	28	30	35	50
Delphinium spp.	Low Larkspur	25	30	35	40	50
Erigeron spp.	Daisies	22	25	30	35	55
Erigeron speciosus	Daisies			33	35	55
Eriogonum spp.	Buckwheat	20-25	30-40	40	50-55	65+
Fraseria speciosa	Showy frasera		20	20		
Galium boreale	Bedstraw	17-20			45-50	
Geranium spp.	Geranium	20	25-30	30-35	40-45	55+
Helianthella uniflora	Oneflower sunflower	20	30-35	38-45	50-55	65+
Heracleum lanatum	Cow parsnip	20	20	20	22	30
Hieracium albertinum	Hawkweed	15-20	25-30		35-40	65+
Lathyrus spp.	Peavine	20	25	29	35	50
Leptodactylon pungens	Granite Gilia				60	
Lithospermum ruderale	Stoneseed	15-20	25-30	40-45	50-55	65+
Lomatium spp.	Biscuitroot	15-20	20-25	26-30	37	

Forbs (cont'd.)

Scientific Name	Common Name	Average Dry Matter Percent by Stages of Development: Pre-Bloom	Full Bloom	Dough Soft Seed	Seed Mature	Curing to Cured
Lupinus spp.	Lupine	18-25	25-30	30-35	40-45	50
Mertensia leonardi	Bluebells	16	20	22	30	50
Orthocarpus spp.	Owlclover	15	20	25	35	45+
Osmorrhiza occidentalis	Sweet anise	18	21	25	30	50+
Penstemon spp.	Penstemon	20	25	30-35	35-40	50+
Paeonia brownii	Peony			30-38	40	
Phlox spp.	Phlox	20-25	35	45	50	70+
Polemonium foliosissimum	Jacobs Ladder	15	20	30	35	60+
Polygonum spp.	Knotweed		25	40	45	
Potentilla spp.	Cinquefoil	15-20	25	30-35	38-45	55+
Rudbeckia occidentalis	Niggerhead	21	25	30	40	55
Salsola tenuifolia	Russian thistle	25	30	45	50	65
Senecio spp.	Groundsel					
integerrimus	Lambstongue	15-20	23-30	30-40	40-45	55+
serra	Butterweed	15-20	25-30	35	40	55+
Stellaria jamesiana	Starwort	23	25	30	31	
Taraxacum officinale	Dandelion		21			65+
Thalictrum fendleri	Meadow-rue	23	30	36	40	
Tragopogon spp.	Salsify	20	30	35	40	
Valeriana occidentalis	Valerian		20		25	
Vicia americana	Vetch		25	30	30	
Viguiera multiflora	Showy goldeneye		30	35		
Viola spp.	Violet	15-20	20-25	30	38	
Wyethia spp.	Wyethia	20-25	25-30	35	40	55+

TABLES FOR CONVERTING GREEN WEIGHT TO DRY WEIGHT BY GROWTH STAGE

PASTURE SPECIES

Scientific Name	Common Name	Average Dry Matter Percent by Stages of Development: Pre-Bloom	Full Bloom	Dough Soft Seed	Seed Mature	Curing to Cured
PASTURE SPECIES						
Medicago sativa	Alfalfa	20	30		39-42	
Melilotus spp.	Sweetclover	20	30			
Trifolium repens	Ladino & Dutch					
Trifolium hybridum	Alsike clover					
Trifolium pratense	Red clover					
Onobrychis sativa	Sainfoin	20	30			
Lotus corniculatus	Trefoil					
Astragalus cicer	Cicer Milk-vetch	20	30			

TABLES FOR CONVERTING GREEN WEIGHT TO DRY WEIGHT BY GROWTH STAGE

SHRUBS AND TREES

Scientific Name	Common Name	Average Dry Matter Percent by Stages of Development						
		Early Leaf	Flowering	Foliage Mature	Late Season	Winter	Dough	Mature
SHRUBS & TREES								
Acer glabrum	Rocky Mt. maple	30						
Amelanchier alnifolia	Service-berry		35	40				
Artemisia arbuscula	Dwarf sage			54	60-75			
Artemisia cana	Silver sage			35				
Artemisia nova	Black sage			50-55	60-75			
Artemisia tridentata	Big sage	35	40	50	55	60		
Artemisia tripartita	Threetip sage			38				
Atriplex confertifolia	Shadscale							
Ceanothus velutinus	Snowbrush	35	45	50	65			
Chrysothamnus viscidiflorus	Little Rabbitbrush	30	37-45	50-60	65	70+		
Chrysothamnus nauseosus	Rubber Rabbitbrush	30-40	45-50	55-60	65	70+		
Eriogonum spp.	Shrubby Buckwheat			50-55	70			
Gutierrezia sarothrae	Snakeweed			40				
Juniperus osteosperma	Oneseed Juniper			58				
Opuntia spp.	Prickly pear		10*	13-15**				
Physocarpus malvaceus	Ninebark				74			
Populus tremuloides	Aspen			37-40	52-56			
Prunus virginiana	Chokecherry							
Prunus emarginata	Bitter-cherry			43	69			

* New Pods forming
** Fruit ripe and drying

INSTRUCTIONS

These tables can be used to assist in converting green weight to dry weight. Many conditions affect the percent dry weight, such as, soil moisture, atmospheric moisture, exact growth stage, etc. This is the reason for the spread in figures for a specific growth period, like full bloom 30-40 percent. The tables are approximate, but will help you to adjust your estimates from green weight to dry weight.

Example: Green weight sample - Crested wheatgrass at soft dough stage = 100 grams.
Dry weight percent = 50 percent

100 x .50 = 50 grams of dry weight Crested wheatgrass

CHAPTER 50

GRAZING IMPACT ANALYSIS

Contents

CHAPTER 50
GRAZING IMPACT ANALYSIS

Determinations made with the grazing impact analysis procedure include forage utilization, trampling damage, soil compaction, plant composition, forage production, herbaceous overstory, use intensities of game, total forage removal, and observation on soils. The information obtained on each bench mark will be recorded on form R4-2200-8, and summarized on form R4-2200-3. The .96, 1.92, 4.8, or 9.6 square-foot plot sizes will be used as the sampling unit.

51 — SELECTING BENCH MARKS. Selected areas within the suitable range will be permanently marked. These will serve as "bench marks" on which measurements and observations will be made to direct management and to guide the manager in his future evaluation of the range. Bench marks must be representative of the primary range and must be areas that will be sensitive to changes in livestock management. The number of such areas required will depend upon the complexity of the vegetation, soil, and topography. As a guide, one bench mark should be established for each 1,000 acres of primary range, although this standard will vary according to the size and complexity of the unit.

51.1 — Rules to be Followed in Selecting Bench Marks.

1. Bench marks must be located on range classified as primary and must be representative of this range classification.

2. Bench marks must not be established on areas of unavoidable concentration such as waterholes, bed grounds, and fence lines. As a general rule, transects should not be established within 200 feet of such concentration areas.

3. Bench marks will be the first to reflect the results of grazing management. For example, on cattle range the meadow edge will normally be properly grazed before much use is made of the meadow proper, and timber openings will generally be overgrazed before significant use is made of the area under the tree canopy. Therefore, the meadow edge and timber opening would be the key to management of these particular ranges.

4. The procedure for selecting bench marks on sheep range will be the same as for cattle range except that the bench mark areas will not necessarily be used as sites for grazing impact analysis. This is because sheep are under control of a herder, and fixed areas can be given special consideration. Because of this, sites for grazing impact analysis should be shifted when necessary to reflect the true grazing pressure on the allotment.

52 — LAYING OUT THE TRANSECT. See Chapter 40, Section 41.1.

53 — RECORDING DATA ON GRAZING IMPACT ANALYSIS, FORM R4-2200-8. See Exhibit 53 in this chapter; also Chapter 40, Section 41.

53-2

~~53-3~~

R-4 RANGE ANALYSIS HANDBOOK

Exhibit 53

GRAZING IMPACT ANALYSIS

BENCHMARK NO. 3

FOREST	RANGER DISTRICT	ALLOTMENT	EXAMINER · DATE
Bannock	Indian Head	Meadow Valley	John Jones 8/20/63

TRANSECT NUMBER	PLOT SIZE*	PLOT INTERVAL	RANGE TYPE	RANGE CONDITION*	CLASS OF USE	SLOPE · ASPECT
1 of 1	.96	2 chains	51 42/30 +	Poor	Cattle	5% SW

LOCATION: ¼ mile West of the upper pond in the Meadow Valley Cr. drainage

ELEVATION: 7,800'

	SPECIES	PLOTS 1	2	3	4	5	6	7	8	9	10	TOTAL PROD.	GRAMS USED	% UTIL
GRASSES	Stle	10(16)	2(4)		T	3(2)			2(3)	7(6)	1(2)	50	25	50
	Kocr		1	1	2	1(2)	5(3)			1(1)	4(3)	24	9	37
	Agsm	4(4)										5	1	20
	Mumo		3(4)	T		1	3(4)					12	5	42
	Stco		3(2)				6(4)					15	6	40
	Cado			1(1)				3				5	1	20
	Feov			1						2		3	0	0
	Pofe			2			1(1)	3(4)	3(2)	1(1)	2(3)	21	9	43
	Total-grasses											135	56	41
FORBS	Triz								.5(1)		.5(1)	1	T	T
	LuKi								1			1	0	0
	Astr	T				3						3	0	0
	Eriz²		T	2		1			T			3	0	0
	Astr²								1(1)			1	T	T
	Agor								1(1)			2	1	50
	Taof	12(12)										24	12	50
	Andi²	5	9	19		T	9		5			47	0	0
	Total-forbs											82	13	16
SHRUBS	Chvi									3(1)		4	1	25
	Arca					45		40	50			135	0	0
	Total-shrubs											139	1	1
												Totals	Averages	
	% OVERSTORY (SHRUB)					10		10	10	T		30	3	
	% CROWN COVER (HERB.)											—	—	
100%	% BARE GROUND	60	60	45	40	30	30	70	40	50	75	500	50	
	% ROCK & PAV. (NATURAL)	0	0	0	30	0	0	0	0	0	0	30	3	
	% ROCK & PAV. (UNNAT.)	5	10	5	20	10	0	0	0	0	0	50	5	
	% VEG. & LITTER	35	30	50	10	60	70	30	60	50	25	420	42	
	% SOIL DISTURBANCE	5	10	5	0	0	0	15	5	5	15	60	6	
	DROPPINGS (Cattle)	1	1	1	1	2	2	2	0	1	3	14	1.4 per ¼ 100 acre	
	PELLET GROUPS (Deer)	1	1	1	1	1	1	1	1	1	1	10	1 " "	

*9.6 SQ. FT. PLOT COMES OUT DIRECTLY IN POUNDS PER ACRE WHEN TEN PLOTS ARE TOTALED. ADD A CIPHER (0) TO TOTALS IF 0.96 SQ. FT. PLOT IS USED.

* This column not to be filled in if more than one transect is run on a given benchmark

FORM R4-2200-8 (4/63)

(OVER)

R-4 RANGE ANALYSIS HANDBOOK

* (See footnote)

NOTES: EFFECT OF CURRENT GRAZING ON THE SITE 1. Grass seedlings are being pulled up (at least 25% loss at this date - 8/20) The numerous sagebrush seedlings are not being injured (.5 seedlings per .96 sq ft. plot)

2. Litter cover is scant and patchy. The heavy forage removal is obviously preventing litter buildup.

3. Soil compaction evident and ranged from moderate to heavy. The plants in the openings between shrubs are much lower in vigor than those immediately adjacent to shrubs. Soil compaction appears to be the major factor contributing to the low vigor of herbaceous species.

ESTIMATED USE BASED ON UTILIZATION OF AIR-DRY FORAGE

CONVERSION FACTORS:

AIR-DRY CONTENT OF GREEN FORAGE

GRASSES & SEDGES	
JUST BEFORE HEADING	25 - 30%
HEADED OUT	35 - 40%
AFTER BLOOM	45 - 50%
SEED MATURITY AND PAST	55 - 80%
FORBS	
VERY LUSH	15 - 20%
FLOWERING	20 - 25%
SEED TIME	30 - 35%
BROWSE	
LUSH LEAVES (SNOWBERRY)	30 - 40%
FIBROUS LEAVES (OAK) & PURSHIA	35 - 45%
RABBITBRUSH & SAGEBRUSH	40 - 60%

AIR-DRY FORAGE PER ANIMAL UNIT

CATTLE UNIT	24# PER DAY
SHEEP UNIT (125# EWE)	4.1# PER DAY
WITH 25# LAMB	5.3# PER DAY
WITH 50# LAMB	6.2# PER DAY
WITH 75# LAMB	6.8# PER DAY

CALCULATIONS

Grasses - 560# x .45 = 252#
Forbs - 130# x .25 = 32#
Shrubs - 10# x .60 = 6#
Total = 290# air dry forage consumed

$\frac{290\#}{24\#}$ = 12.1 cow days per acre estimated actual use

ESTIMATED USE

BASED ON PELLET OR DROPPINGS COUNT

CONVERSION FACTORS:

13 PELLET GROUPS PER SHEEP DAY

12 DROPPINGS PER COW DAY

PLOT SIZE 1/100 ACRE

A. 3.3 FT. ON EACH SIDE OF TRANSECT LINE

OR

B. SUPERIMPOSED CIRCULAR PLOT WITH AN 11.7 FT. RADIUS

FORMULA FOR A

$\frac{\text{DROPPINGS PER TRANSECT}}{\text{CHAINS PER TRANSECT}} \times \frac{100}{12} = \text{COW DAYS PER ACRE}$

FORMULA FOR B

$\text{AVERAGE DROPPINGS PER PLOT} \times \frac{100}{12} = \text{COW DAYS PER ACRE}$

CALCULATIONS

For cattle

$\frac{1.4 \times 100}{12}$ = 11.7 cow days use per acre

For deer

$\frac{1 \times 100}{13}$ = 7.7 deer days use per acre

* Where more than one impact transect is run on a given site, the information shown here should be entered only on reverse of summary form.

*-53.1 – **Determining Forage Production, Forage Utilization, and Percent Composition.** Production, utilization, and percent composition are determined in one operation. Through a combination of weighing and estimating, the weight of forage (in grams) remaining and consumed is determined for each species within each plot.

Where the .96 square-foot plot is used, grams are converted to pounds per acre by adding a "0" to the total of the 10 plots. When the 9.6 square-foot plot is used, the summation of the 10 plots is equivalent to pounds per acre. Where the 1.92 square-foot plot size is used add a "0" to the summation of the plots and divide by two. For the 4.8 square-foot plots multiply the sum of the 10 plots by two to obtain pounds per acre.

1. *Vegetation to Include in Plot.* All portions of the plants within the plot and the overhanging portion of outside plants which fall within the plot are considered in the determination. Portions of plants that extend outside the plot are not considered. (See Exhibit 41-C.) Record all current growth of browse plants which falls within the plot and is available to grazing animals.

2. *Developing Weight Units.* Portions of various plants will be weighed to develop weight units. Knowing the relative weight of each plant part is essential in estimating amount of forage removed. Some of the most usable weight units are stems, small plants, leaves, and weight per square-inch basal area. Relation of leaf weight to stem weight aids in estimating. Ten to 20 similar plants or plant parts such as individual leaves or leaf clusters can be weighed together and the average weight developed. Weight estimates between ½ gram and 1 gram will be recorded as a gram; weight estimates less than ½ gram will be recorded as a trace. Traces will not be added in figuring total production of a transect.

3. *Forage Left.* Weigh or estimate the weight in grams of the remaining portions of each species in the plot. Record this weight in the left half of the space provided on the form.

4. *Forage Consumed.* Estimate the weight in grams of the amount of each forage plant consumed by the grazing animal. Compare grazed with ungrazed plants to develop proficiency in estimating. Record this weight in the right half of the same space, and enclose it with a quarter circle.

5. *Total Production.* Total production is the sum of all the plot estimates remaining and consumed. Where more than one transect is run on a site, this form need not be completed beyond the total production column.

6. *Percent Utilization.* Grams used divided by total production in grams.

$$\text{Percent utilization} = \frac{\text{grams used}}{\text{total production}} \times 100$$

7. *Dry Weight Production.* Convert green weight to dry weight. The guides on the back of form R4-2200-13 may be used. However, the dry weight tables in Exhibit 41-D will give a higher degree of accuracy. Where more guidance is needed, make actual dry weight determination.

8. *Percent Composition.* Percent composition will be determined on a dry weight basis. Divide the total dry weight of each species by the total dry weight production on the transect, times 100, to get percent composition of each species. The total of the various determinations in the "percent composition" column must total 100. -*

*-9. Desirability Rating. Desirability rating of the species will be based on the appropriate species list. (See Exhibits 41-H or 41-I.) These will be designated as follows: "D" (Desirables), "I" (Intermediates), "L" (Least Desirables). Where the desirability rating is split for a given species, show the share of each rating thus: e.g., "D" - 5%, "I" - 13%. Total the percentage of Desirables, Intermediates, and Least Desirables. The total of all classifications must equal 100.

53.2 - Overstory Vegetal Cover. Shrub overstory and herbaceous crown cover will be treated the same as in Chapter 40, Section 41.22.

53.3 - Ground Cover Determination. See Chapter 40, Section 41.23.

53.4 - Soil Disturbance - Displacement and Compaction. Trampling by livestock or big game results in soil disturbance, which is characterized by both soil displacement and compaction. Soil displacement is a factor of concern on light or loose soils, particularly on slopes. Compaction is common on heavier soils and on level areas. Both can be damaging.

1. Soil Disturbance and Displacement. Trampling activity on the sandier soils will result in displacement rather than compaction. The effects are most pronounced under dry conditions when considerable amounts of soil may be "walked" downslope in this manner.

Record the percentage of the soil disturbed within each plot. Soil disturbance measurements should be made immediately after grazing; otherwise, rainstorms may obliterate the signs. The rating will be based on the total area affected.

None	- less than 1 percent
Light	- 1 to 10 percent
Moderate	- 11 to 30 percent
Heavy	- over 30 percent

2. Soil Compaction. The commonly used measure of compaction is bulk density. Without laboratory determinations, compaction is often difficult to appraise--especially in the initial stages. Increased density of the immediate surface layers will be appraised in range analysis by careful visual examination of the structure and examination of the consistence. The surface structure and consistence of soils in grazed areas will be compared to the structure and consistence of similar site and soils of adjacent protected areas. Soil compaction will be judged as being either none, light, moderate, or heavy.

53.5 - Use Intensity Determination. Use intensity is determined by the amount of forage consumed as obtained from utilization data and by dropping and pellet group counts. On established bench marks utilization data is generally the most reliable.-*

*-1. Forage Consumption. This is calculated on the back of form R4-2200-8. The grams used are converted to dry weight, then by formula dry weight is converted to animal days per acre. The formula is:

$$\frac{\text{Dry weight}}{\text{Consumption factor}} = \text{Animal days per acre}$$

Guides for converting green weight to dry weight on the back of forms R4-2200-8 and in the dry weight table (Exhibit 41-D) should be supplemented by periodic determinations in the field. This is done by collecting samples and letting them dry in a cloth or paper bag, then applying the following formula:

$$\frac{\text{Dry weight minus bag weight}}{\text{Green weight minus bag weight}} \times 100 = \text{Percent dry weight}$$

2. Pellet Group Transects. As a check on game utilization, pellet group transects should be run concurrently with the grazing impact studies. Circular 1/100-acre plots (11.7-foot radius) having a common center with the weight estimate plots are commonly used. Pellet group counts may also be conducted as separate determinations.

53.6 - Effect of Current Grazing on the Site. The back of form R4-2200-8 is a place to show effects of current grazing on the site. At least the appropriate following points should be commented upon. (See example, Exhibit 53.)

1. Age class distribution in shrubs.
2. Distribution of age classes of forage species.
3. Destruction of seedlings through trampling or pulling up.
4. Breaking up or uprooting of mature plants.
5. Undercutting of plants from excessive soil movement.
6. Burying of plants from excessive soil movement.
7. Breaking up of litter cover or displacement as a result of trampling.
8. Soil compaction - Light, moderate, or heavy.
9. Rodent activity.

54 - SUMMARY FOR GRAZING IMPACT ANALYSIS, FORM R4-2200-3. Form R4-2200-3 will be used for summarizing data from two or more transects of grazing impact analysis made on one bench mark. Data from the "total production" and "grams used" columns of form R4-2200-8 will be transferred to form R4-2200-3. "Average production" (green weight) and "average grams used" (green weight) will be obtained by averaging these data. "Average utilization" will then be calculated by dividing "average grams used" (green weight) by "average production" (green weight). The last column will be used for converting the average production to dry weight. All elements of ground cover, soil disturbance, pellet and dropping counts will be averaged at the bottom of the form. Average use intensity, based on forage removal (back of form R4-2200-8) along with slope, aspect, and elevation will be entered in the lower right-hand corner of the form. (See example, Exhibit 54.)-*

R-4 RANGE ANALYSIS HANDBOOK

Exhibit 54

SUMMARY FOR GRAZING IMPACT ANALYSIS

BENCHMARK NO. 3 LOCATION ¼ mile west of upper pond in Meadow Valley Creek

Bannock (FOREST) Indian Head (RANGER DISTRICT) Meadow Valley Cattle (ALLOTMENT) John Jones 8/20/63 (EXAMINER - DATE)

	SPECIES	TRANSECT I TOT. PROD.	TRANSECT I GRAMS USED	TRANSECT II TOT. PROD.	TRANSECT II GRAMS USED	TRANSECT III TOT. PROD.	TRANSECT III GRAMS USED	AV. PROD. (GR. WT.)	AV. GRAMS USED (GR. WT.)	AV. UTIL. %	AV. PROD. (DRY WT.) Lbs. Per Acre
GRASSES	Stle	50	25	45	23	33	15	43	21	49	215*
	Kocr	24	9	12	6	8	3	15	6	40	68
	Agsm	5	1	15	7	8	2	9	3	33	45
	Mumo	12	5	20	9	17	7	16	7	44	80*
	Stco	15	6	5	1	4	1	8	3	38	40
	Cado	5	1	8	1	7	1	7	1	14	35
	Feov	3	0	5	3	7	3	5	2	40	25
	Pofe	21	9	18	10	25	14	21	11	52	94*
	Stsp			3	0	T	0	1	0	0	5
	Total								54		607
FORBS	Eriz	1	T	3	2	2	1	2	1	50	5
	LuKi	1	0	8	0	7	0	5	0	0	14
	Astr	3	0	1	0	5	0	3	0	0	10
	Eriz²	3	0	4	0			2	0	0	7
	Astr²	1	T	3	0	11	0	5	0	0	17
	Agoz	2	1	2	1	3	2	2	1	50	5
	Taof	24	12	30	14	27	16	27	15	56	68
	Andi²	47	0	11	0	12	0	23	0	0	69
	Senz			12	0	2	0	5	0	0	15
	Latz			5	1	8	0	4	T	T	12
	Viam			4	2	2	1	2	1	50	5
	Total								18		227
SHRUBS	Chvi	4	1	15	3	11	3	10	2	20	45
	Arca	135	0	105	0	153	0	131	0	0	655
	Total								2		700
	TOTAL							346	44	21	1,534
								AVERAGE			

	% OVERSTORY (SHRUB)	4	3	5	4
	% CROWN COVER (HERB.)	45	53	60	53
100%	% BARE GROUND	50	43	40	44
	% ROCK & PAV. (NAT.)	3	0	0	1
	% ROCK & PAV. (UNNAT.)	5	8	4	6
	% VEG. & LITTER	44	49	56	49
	% SOIL DISTURBANCE	15	22	17	18
	DROPPINGS – Cattle	1.4	1.5	1.3	1.4
	PELLET GROUPS – Deer	1	.8	.7	.8

% SLOPE - ASPECT: 0-5 SW

ELEVATION: 7,800

AV. USE INTENSITY: 13 cow days per acre based on forage removal

* Key species

R-4 RANGE ANALYSIS HANDBOOK

NOTES: EFFECT OF CURRENT GRAZING ON THE SITE

1. Grass seedlings are being pulled up (at best a 25% loss at this date – 8/20) The numerous sagebrush seedlings are not being injured (.5 seedlings per 96 sq. ft. plot)

2. Litter cover is scant and patchy. The heavy forage removal is obviously preventing litter buildup.

3. Soil compaction evident and ranged from moderate to heavy. The plants in the openings between shrubs are much lower in vigor than those immediately adjacent to shrubs. Soil compaction appears to be the major factor contributing to the low vigor of herbaceous species

ESTIMATED USE BASED ON UTILIZATION OF AIR-DRY FORAGE

CONVERSION FACTORS:

AIR-DRY CONTENT OF GREEN FORAGE

GRASSES & SEDGES	
JUST BEFORE HEADING	25 - 30%
HEADED OUT	35 - 40%
AFTER BLOOM	45 - 50%
SEED MATURITY AND PAST	55 - 80%
FORBS	
VERY LUSH	15 - 20%
FLOWERING	20 - 25%
SEED TIME	30 - 35%
BROWSE	
LUSH LEAVES (SNOWBERRY)	30 - 40%
FIBROUS LEAVES (OAK) & PURSHIA	35 - 45%
RABBITBRUSH & SAGEBRUSH	40 - 60%

AIR-DRY FORAGE PER ANIMAL UNIT

CATTLE UNIT	24# PER DAY
SHEEP UNIT (125# EWE)	4.1# PER DAY
WITH 25# LAMB	5.3# PER DAY
WITH 50# LAMB	6.2# PER DAY
WITH 75# LAMB	6.8# PER DAY

CALCULATIONS

Grass – 540# X .50 = 270#

Forbs – 180# X .25 = 45#

Shrubs 20# X .45 = 9#

Total = 324# Air-dry forage consumed

$\frac{324\#}{24\#}$ = 13.5 cow days per acre estimated actual use

ESTIMATED USE

BASED ON PELLET OR DROPPINGS COUNT

CONVERSION FACTORS:

13 PELLET GROUPS PER SHEEP DAY

12 DROPPINGS PER COW DAY

PLOT SIZE 1/100 ACRE

A. 3.3 FT. ON EACH SIDE OF TRANSECT LINE

OR

B. SUPERIMPOSED CIRCULAR PLOT WITH AN 11.7 FT. RADIUS

FORMULA FOR A

$$\frac{\text{DROPPINGS PER TRANSECT}}{\text{CHAINS PER TRANSECT}} \times \frac{100}{12} = \text{COW DAYS PER ACRE}$$

FORMULA FOR B

$$\text{AVERAGE DROPPINGS PER PLOT} \times \frac{100}{12} = \text{COW DAYS PER ACRE}$$

CALCULATIONS

For cattle

$\frac{4.4 \times 100}{12}$ = 11.7 cow days use per acre

For deer

$\frac{.8 \times 100}{13}$ = 6.2 deer days use per acre

55 — UTILIZATION CAGES. Utilization cages will be used to aid in grazing impact analysis determinations.

55.1 — Kinds of Utilization Cages. Any exclosure that will give protection from grazing to a small representative sample of forage during the grazing season and that will not appreciably disrupt normal vegetation growth, can serve as a utilization cage. Three commonly-used cages are described below.

1. *"Hanson" Net Wire Type.* This type is made from 48-inch wire netting with 6-inch mesh. The bottom and top wire is No. 9, the inner wire No. 12. Steps in construction are:

a. Cut net wire into approximately 12-foot lengths. To obtain a 12-foot length, the netting must be cut at the twenty-fourth 6-inch mesh. However, to allow the "nesting" of 3 baskets they can be made by cutting the net wire at the twenty-third, twenty-fourth, and twenty-fifth 6-inch mesh.

b. Bring ends of cut strip together and wire with the loose ends to form a circular basket.

c. Cut the top three wires at each quarter.

d. Fold the cut quarters as in closing a pasteboard box and wire together with the loose ends.

2. *Agronomy Cages.* These are heavy net wire cages commercially constructed. They can be ordered through United Steel & Wire Co., 27 Fonda Avenue, Battle Creek, Michigan. Cost is approximately $10 each.

3. *Rigid Steel Post Cage.* These are constructed by driving four steel posts in the ground to mark off the area desired to protect, making them firm by bracing from one pole to another and encircling with either net or barbed wire. These are very stable but difficult to move. They are also expensive.

55.2 — Use of Utilization Cages. Utilization cages are used:

1. To provide a guide to utilization and production on the study area. Both shrubs and herbaceous vegetation can be protected from grazing by these cages. The cages must be moved each year at the beginning of the grazing season. This will allow for comparison of the rangelands inside and outside the protected plot.

2. As demonstration plots to show utilization rates to stockmen and other interested people.

3. To collect information showing forage production fluctuations due to yearly climatic changes.

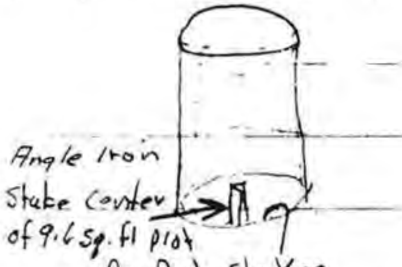
4. To determine proper use of meadows and seeded areas where use is based on maintenance of optimum vigor. Two- to six-paired plots should be used on each site being studied.

2/10/6?

Charlie:

Personnel Section is [illegible] another Corr. Course for use [illegible] [illegible].

utilization cage



Height - Standard of wire 5' or 6'
Cut wire to form circle 131.8 inches
in circumference - allow enough [illegible]
in cutting to tie ends together [illegible]
Still have your 131.8 in. circum.
This size just fits a 9.6 sq. ft. plot
If you haven't got a 9.6 sq. ft hoop [illegible]
one out of NO.9 wire 131.8 circumference
Connect with telephone wire sleeve Micro press. Connecto
Drive angle iron stake on sites [illegible]
for center of plots Put cage over one stak
and spike to ground with bridge spikes or
concrete re-rod. Leave one plot un cage w/ angle
iron stake to measure utilization against the
caged plot. (over)

It is important to select the sites for plots at the time of installing the cages if they are uniformly representative. Selecting and marking the uncaged plot at time cage is set out eliminates bias in the fall when you measure.

To measure in fall remove cage and put your 9.6 sq ft hoop over area formed by cage and proceed with measuring plants by species or by type - grass forbs & browse etc. Record on form. Then place hoop over comparison plot centering the angle iron stake with the hoop. Clip and weight same as caged plot Caged plot gives you seasons total production for the site - uncaged plot gives you the amount used by stock - difference is percent of utilization.

If you need help Charlie, I can give you a hand.

Dub

When the 9.6 square foot plot is used, the summation of 10 plots is equivalent to ~~hundredths~~/acre & if one is used it can be blown up by ten times the results

CHAPTER 60
PROPER USE DETERMINATION

Contents

CHAPTER 60
PROPER USE DETERMINATION

The application of proper grazing use on National Forest livestock and game range is the objective of the range analysis program. Range condition and trend is extremely important in determining proper use and will weigh heavily in determining the nature of management applied when range and watershed conditions are satisfactory. Sustained harvest of the annual forage crop is the objective of management. Where the range-watershed is not in satisfactory condition, the primary objective is restoration to a satisfactory condition followed by sustained-yield management.

Following the analysis of the allotment, observations are made of grazing use and its effect on various sites and conditions. These observations are compared with established proper use criteria and used as a guide in firming up grazing capacity or they can be used in the development of suitability criteria.

61 — BASIS FOR DETERMINING PROPER USE. The amount of grazing that a site in satisfactory condition can stand and maintain itself in such condition depends on a number of factors. The more important are slope, aspect, species composition, soil structure and type, season of use, and class of grazing animals. In mountainous areas typical of Region 4, this complex of factors becomes very pronounced. On sites where conditions are not satisfactory, restoration becomes a major problem.

To evaluate the impact of grazing on an area, it is necessary to understand the influence of grazing on the soil and vegetation. Through the years, considerable research has been directed toward an understanding of effects of grazing on numerous plants and soil types.

The purpose of this section of the Handbook is to briefly summarize some of the research findings. These will be discussed under the following headings:

1. Effects of herbage removal on the plants.
2. Selective grazing habits of the animals.
3. Mechanical effects of grazing on the plants and soil.
4. Vegetal cover as a factor in site stability and its relation to grazing use.
5. Results of grazing trials on mountain rangelands.

61.1 — Effects of Herbage Removal on the Plants. Plants grow as a result of photosynthetic processes that take place in the green foliage. When foliage is removed during the growing season, the food-manufacturing process is reduced until foliage is restored.

Foliage can be replaced only at the expense of stored food (starch) in the basal portions and roots of the plant. If the foliage removal is too serious or continuous, the plant may weaken and die.

Numerous studies made in the field and in the greenhouse have shown the effects of foliage removal on grasses. Studies by Robertson (1933), Carter and Law (1948), and Branson (1956), showed that the reduction of photosynthetic surface by clipping reduced production of both herbage and roots. Biswell and Weaver (1933), found that the lowering of production was directly related to the severity and frequency of herbage removal. Herbage removal may affect production immediately or it may be reflected in the next year's crop as was observed by Weaver and Hougen (1939). Crider (1955), in a carefully controlled greenhouse study using both northern and warm climate species, showed that degree of foliage removal had marked effect on root production.

In Crider's study, removal of half or more of the foliage upset the functioning of the root system and the plant as a whole. A single removal of 50 percent of the foliage stopped growth of 8 percent of the roots. Where removal was continued three times weekly until the end of the study, 52 percent of the roots had stopped growth.

In reviewing the Crider study, "Agricultural Research" for July 1954 states: "This is striking evidence that close grazing or mowing during the growing season, especially in periods of stress or in the late fall, may be practiced at the expense of stand establishment and maintenance."

A study by Jantti and Leinonen (1957), showed that the reduction of growth in grass plants after cutting or grazing was due partly to the inability of defoliated plants to absorb water against a moisture tension of more than one or two atmospheres. This point would be very important in the West where moisture supply is generally the limiting factor to growth.

One of the more important bunchgrasses in the Region (*Agropyron spicatum*) has been given attention by several investigators, Hanson and Stoddart (1940), Stoddart (1946), McIlvanie (1942), Heady (1950), and Blaisdell and Pechanec (1949). All showed detrimental effects of heavy grazing from lower production to death loss.

Julander (Line Project Report - Intermountain Forest and Range Experiment Station April 30, 1958), after nine years of study, found that "forbs cannot withstand more than [illegible] percent utilization. Heavier use resulted in loss of plants, decreased forage production, and decrease in seed stalk production."

61.2 — Selective Grazing Habits of the Animals. Selective grazing habits of different classes of livestock and species of big game animals is another factor bearing on the amount of use a range area can stand. When one class of livestock uses an area over an extended period of time, the plant composition changes. This change in composition has been used by grazing technicians to evaluate range condition. Weaver and Hanson (1941) classified forage plants into three categories, based on their response to grazing, which they called decreasers, increasers, and invaders. Others have since followed this classification, Dyksterhuis (1949), Voight and Weaver (1951), and Tolstead (1942).

The selective habit of grazing animals prompted the development of palatibility lists and the term "class overgrazing," Jardine and Anderson (1919). Ellison (1954) found ranges overgrazed by cattle to be dominated by such forbs as *Geranium*, while those overgrazed by sheep were dominated by *Stipa* and *Taraxacum*.

Hormay (1956), in discussing continuous seasonal grazing, states: "Even under light or moderate stocking, a portion of the range is destructively grazed because of the selec-

tive grazing habits of livestock. Particularly, plants on particular areas are cropped closely year after year and gradually killed out."

61.3 — Mechanical Effects of Grazing on the Plants and Soil. Trampling by grazing animals has two major effects on the soil. First, it disturbs the litter and the soil; and second, it causes compaction. Soil disturbance by grazing animals was found to be particularly damaging to loose soils such as those of sandstone or granitic origin. Slopes are also more subject to soil movement due to grazing than are level areas. In speaking of the granitic soils of the Boise River Watershed, Craddock and Pearse (1938) stated that "Observations show the soils to be highly susceptible to disturbance by trampling of livestock while grazing." Renner (1936) observed livestock trampling to be a major factor in range deterioration and erosion. He states that "Heavy grazing with its attendant trampling is the primary cause of accelerated erosion in the wheatgrass type . . ." He further states that "With heavy grazing use, much of the vegetation material that otherwise might have gone into enrichment of the soil either is removed through actual grazing or so broken up through repeated trailing . . . . that it is easily carried away by wind and surface runoff."

Packer (1953), in his studies on the effects of trampling on the range, found that "All levels of trampling disturbance reduced the amount of ground cover and increased the size of the bare soil openings . . . ." He found from his trampling studies on granitic soils of Idaho that on a site with 90 to 95 percent cover (vegetation and litter) that trampling up to 60 percent (measured) did not reduce the cover below 70 percent nor increase the bare soil openings above a safe minimum of four inches in the wheatgrass type. Where trampling did not reduce the cover below 70 percent, erosion rates were not affected. On sites with 80 to 85 percent cover, trampling rates up to 20 percent did not materially affect the minimum requirements of plant-litter cover. On sites with 70 to 75 percent cover, all degrees of trampling disturbance in excess of 10 percent reduced the ground cover below the safe minimum of 70 percent and resulted in accelerated soil erosion. In other words, to prevent a site from deteriorating, it is necessary to maintain a cover of near two-thirds even after grazing use.

Observations in the field show that any appreciable movement of the soil as a result of trampling can do damage to both established plants and seedlings.

Profile studies of the soil on grazed slopes showed that sheep grazing disturbed the soil to a depth of one to two and one-half inches. As the soil is moved down the slopes, plants may be buried on their uphill side and roots exposed on the downhill side. With this rate of soil movement, it is impossible for seedlings to become established in bare openings.

On dry, loose soils, plants are also susceptible to pulling. Observation by Lewis and Fickes on a site of dry granitic soils showed that a large percent of the Idaho fescue plants had been pulled up after sheep grazing. Also, the same situation was noted by McConkie and Worf on the Hogs Back Ridge on the Uinta National Forest.

"Soil compaction can be defined briefly as the packing together of soil particles by instantaneous forces exerted at the soil surface resulting in an increased soil density through a decrease in pore spaces," Lull (1959).

Soil compaction is one of the more detrimental effects of grazing. Some of the important basic results of compaction should be understood by the range manager so that they can be minimized through proper stocking and management.

Some of the effects of compaction are reduced infiltration capacity and slower water movement in the soil; an increase in surface runoff because water cannot enter the soil

as rapidly as it is applied; accelerated soil erosion resulting from surface runoff; and reduced pore space which restricts air circulation in the soil and results in poor aeration of the roots. All of the above effects will have an influence on growth and production of herbage. Herbage not only furnishes forage for grazing animals but gives protection to the soil surface.

Degree and ease of compaction depend on three major factors: Soil texture, moisture content, and organic matter content. Huberty (1944) found that soils with a wide range of particle size can be compacted to greater densities than soils of uniform-size particles. Medium textured soils would be silt loams, clay loams, and sandy loams. However, compacting force has a greater effect on clay than upon sandy and silty clays.

Moisture content influences the compaction possibilities on grazed land possibly more than anything else. Wet soils are easily compacted. For this reason it is important not to graze ranges too early in the spring before the soil dries.

Soils high in organic matter are not as subject to compaction as are those with a low organic content.

Compaction considerable effects on infiltration and percolation. Studies in North Carolina woodlots showed that infiltration was reduced from 67 to 80 percent as a result of grazing, Johnson (1952).

Alderfer and Merkle (1941), in the study of percolation rates on a silt loam soil, found that the rate was 25 cc. per minute on a forest site, 18 cc. per minute on unpastured bluegrass, and 5.5 cc. per minute on permanent bluegrass pasture.

Grazing on wet clay loam under a good grass sod resulted in extreme compaction, Peele (1955). A site grazed while the soil was wet had an infiltration rate of 0.40 inches per hour, while soil on an ungrazed site received water at the rate of 2.12 inches per hour.

In studies of water intake rates on a silt loam on the Big Horn Mountains of Wyoming, Rauzi (1955) found a significant difference in the infiltration rate of heavily and lightly grazed pastures. The infiltration rate was 31 percent greater on a lightly grazed pasture as compared to the heavily grazed pasture. This difference was found even though both of the study pastures had a nearly complete cover of vegetation and litter.

Edmund (1958) found that the main effect of treading on short-rotation ryegrass, red and white clover pastures, was the reduction of recovery growth (60 percent reduction in yield after treatment simulating the treading of 20 sheep per acre for 30 days and 10 to 20 percent from the equivalent of four sheep per acre).

Cattle, because of their greater weight, affect the soil to greater depths than do sheep. Cattle may affect the soil to depths of 4 to 6 inches, while sheep may only affect the first 0.5 to 1.5 inches. In both cases the surface soil may be puddled, which is particularly harmful. Where the soil surface is protected by a dense cover of vegetation or litter, the harmful effects of trampling are greatly reduced, O'Connor (1956 and 1957). However, where pastures were clipped, treading resulted in as much as 30 percent reduction in production.

61.4 — Vegetal Cover as a Factor in Site Stability and its Relation to Grazing Use. Vegetal cover is one of the major indicators used in determining range condition. Studies on widely mountain soil show that at least a two-thirds cover of living plants and litter is essential for soil protection, Packer (1951), Marston (1952), and Orr (1957).

Grazing use which lowers the protective cover below the safe minimum is detrimental. Packer (1953) found that the trampling effects alone reduced soil cover and

increased the size of the bare soil openings. Where the forage is removed by the grazing animals, the protective cover may be greatly reduced. This cover removal may be a serious problem on predominantly forb ranges such as the tall forb type of the subalpine zone of Region 4. Here the overstory of 70 percent will meet the minimum cover requirements for the soil. Clipping half of the foliage may reduce the protective cover from 70 to 40 or 50 percent, while a 75 percent removal may reduce the effective soil cover below 25 percent. The reason for this high reduction of cover in the tall forb type in the basal area is small in relation to the overstory. Often this relationship is on the order of 1 to 4. Also, under grazing, litter on forb range is very light; consequently, when the tops are removed, only the small basal area is left to protect the soil.

61.5 — Results of Grazing Trials on Mountain Rangelands. Observations made of livestock grazing under field condition give the most conclusive information on the effects of livestock use on soil and vegetation. Two recent studies of actual field trials are discussed below.

Johnson (1953) reports on three intensities of cattle grazing under season-long grazing on the Front Range of Colorado. Cattle numbers were adjusted in the pastures to obtain the three degrees of herbage removal of the grasses and sedges. Heavy use was defined as 50 percent and above, moderate use was 30 to 40 percent, and light use 10 to 20 percent. After the first year these stocking goals were obtained. Results of the various grazing intensities follow:

Heavy forage use resulted in a decrease in production from 351 pounds per acre (air-dry) in 1942 to 195 pounds per acre in 1947. Also, there was a decrease in such plants as mountain muhly and an invasion of short grasses like blue grama. Such forbs as trailing daisy (an indicator of overgrazing) also increased on the heavily grazed areas. Under both light and moderate grazing, the vegetal cover and production were maintained on the same level as was found at the beginning of the experiment in 1942. Records from all the pastures reflected climatic factors by seasonal fluctuation.

As a result of this study, Johnson recommended utilization of 40 percent or less on grasses and sedges. With herbage utilization of 50 percent or more, production was progressively lowered; therefore, this heavy use was not recommended.

Another interesting study is the cooperative project on the Big Horn Mountains of Wyoming. Organizations participating are the United States Forest Service, the Wyoming Natural Resource Board, and the Wyoming Agricultural Experiment Station, Johnson (1957) and Beetle (1956).

Pastures were set up and cattle numbers adjusted each year to obtain different use intensities. Use based on forage utilization is expressed in terms of leaf length of Idaho fescue. Heavy use was defined as 75 percent use of Idaho fescue, moderate use 50 percent, and light use 25 percent. Actual utilization results obtained in the study were heavy, 65 percent; moderate, 46 percent; and light, 17 percent. Summary of changes that have taken place in the study pastures after five years are summarized as follows:

A. Density Changes

Grazing Intensity	*Granitic Soils*	*Sedimentary Soils*
Heavy	−56%	−73%
Moderate	−54%	−20%
Light	− 8%	−20%

B. Production Changes

Heavy	−56%	−64%
Moderate	−32%	−14%
Light	+44%	+34%

Changes reflected in Idaho fescue, the key species, were summarized thus: Under light use there has been no change, under moderate use a slight loss, and under heavy use a marked decline.

In the 1958 annual report of the Rocky Mountain Forest and Range Experiment Station, the results of the Big Horn studies to that date show the following: "The percent utilization below which production increased and above which production decreased, on an average, was 43 percent on soil derived from sedimentary rocks, 48 percent on granitic, and 46 percent on all soil combined. Presumably, these amounts would approximate the maximum average utilization of Idaho fescue allowable over a period of years for range maintenance on ranges of the type under study."

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62 — FACTORS USED IN PROPER USE DETERMINATION. Factors used in proper use determination are trend in condition, forage utilization, soil disturbance due to trampling and ground cover. This data will be gathered during grazing impact analysis (see Chapter 50).

62.1 — Trend in Condition. Trend is a total result of grazing use and management. It is the final determinent of proper use. Other measurements and observations are only the best approximations and final interpretations must be tied eventually to trend.

62.2 — Forage Utilization. Forage utilization is one of the best measurable factors used in judging proper use. Forage plants should be utilized only to the extent that they can be maintained in a vigorous condition on good and excellent range, and will provide for an increase in both vigor and abundance on ranges in fair, poor, or very poor condition. Under season-long grazing, which is the common practice at present on Region 4 allotments, 50 percent use of the key species is the established maximum. Wet meadows in good condition are the exception. Here up to 60 percent use can be allowed, provided vigor and production are not adversely affected. The 50 percent use rate applies only to ranges in satisfactory condition. Utilization will be graded down from the 50 percent maximum to conform to local range condition, soil stability, and known individual plant requirements. The 50 percent utilization will apply specifically only to forage plants during the growing periods. Dry forage can stand more use so long as mechanical damage to the soil and cover is not a limiting factor. Also, plants can conceivably stand heavier utilization where systems of rest rotation are being used. There is not, however, sufficient research on this type of management to furnish good guidance. Until research findings or administrative experience confirms that heavier utilization can be allowed, utilization exceeding 50 percent will be used only on a trial basis.

62.3 — Forage Vigor. Forage vigor is one of the best checks on the effects of current use on meadows and seeded areas. A good way to check vigor is by use of paired utilization cages. One cage is maintained permanently, while the other is moved each year. Comparing the average maximum leaf length of the protected and unprotected grasses provides a measure of plant vigor.

Vigor standard — based upon percent of average maximum length of leaves.

Excellent	= 95% or more of maximum
Good	= 94% - 85%
Fair	= 84% - 70%
Poor	= 69% - 50%
Very poor	= 49% or less

62.4 — Soil Disturbance Due to Trampling. Trampling of the soils by grazing animals may result in either soil displacement or soil compaction. This effect of grazing may become critical before the maximum allowed use of the key species is reached; in this case the soil displacment or compaction will determine the limit of allowable grazing use rather than utilization of key species.

62.41 — Soil Displacement. Soil displacement, as here defined, is the mechanical movement of the top layer of soil (1 to 3 inches) downslope as a result of livestock grazing. The movement of this layer of soil not only results in a net loss of topsoil but is very

damaging to the plants and ground cover. Damage to the plants is characterized by burying, exposure of roots, plowing out of the seedlings and young plants and breaking of the tough surface shield made up of roots and vegetation that gives the site its stability under pristine conditions.

Slopes on light sandy soils are particularly susceptible to trampling damage resulting in soil displacement. Heavier soils may resist this mechanical displacement to a large degree. Proper use guides based on soil displacement should stay within the following standards. On steeper slopes and on loose, sandy soils evidence of trampling should not exceed 10 percent (light) as determined within the plots. On areas under 5 percent slope and/or heavier textured soils up to moderate (11 to 30 percent) trampling can be tolerated (see Chapter 40, Section 41.24-1).

62.42 — Soil Compaction. Soil compaction is detrimental on heavy soils, particularly if they are wet. Meadows are most susceptible to compaction. Compaction lowers the infiltration capacity and reduces the pore space which has an adverse effect on both available moistures and aeration. This results in greatly reduced production. Proper use should not allow for more than moderate compaction (see Chapter 40, Section 41.24-2).

62.5 — Ground Cover. One of the main objectives of proper grazing use is to maintain sufficient vegetation and litter on the ground to adequately protect the soil. Research points up that at least 60 to 70 percent ground cover is necessary to protect the soils on mountain slopes.

62.51 — General Ground Cover Requirements. It will be the objective in determining proper use to plan for the maintenance of, or the restoration of, at least a 60 percent ground cover.

62.52 — Ground Cover Maintenance in Tall Forb Communities. In tall forb communities the maintenance of adequate ground cover under grazing use is a big problem. The sparse litter cover which makes up much of the ground cover under this type disappears quite rapidly under excessive grazing use, thus leaving the soil without adequate protection. Under a full stand of tall forbs the herbaceous crown cover can give a high degree of protection to the soil, provided the grazing use is very conservative. Under normal grazing use the highly palatable plants common to this type are grazed down to the main stems. This leaves the soils exposed to the full force of the elements for a part of the season.

In planning proper use in tall forb types, provisions should be made to allow for adequate cover after grazing to protect the soil. This may mean that as much as three-fourths of the total vegetation must remain after grazing.

63 — PROPER USE CRITERIA. Proper use criteria are developed from information gained from grazing impact analysis coupled with field observations and research findings. It is of necessity that they be based on the grazing factor that becomes critical first. Where similar soils and vegetal types extend over an entire allotment or group of allotments, a given set of proper use criteria may be applicable to the entire allotment or group of allotments. On the other hand, where mixed soils and vegetal types exist, it is necessary to develop separate use criteria for each important situation. For example, meadows will have different criteria than level bottom lands; and ranges in poor condition will generally require different criteria than those in good condition. (See Exhibit 63, Sample of Proper Use Criteria.)

Exhibit 63

SAMPLE

PROPER USE CRITERIA

Bear Creek C&H Allotment

Prepared: June 16, 1961

By: JOHN BROWN

As a result of observation, trend study results, and grazing impact analyses, the following use criteria will be followed:

1. On bench marks 1, 2, and 7 (in meadow type), the overall use of 45 percent is considered to be proper. Paired cages showed lowered vigor and production at all plot sites where this use was exceeded.

2. The sagebrush benches in lower Bear Creek with slopes under 10 percent — bench marks 3, 4, 5, and 6 — are on moderately deep to deep basalt soils with a low erodibility index (I - II). The following key species should be grazed not to exceed 45 percent: *Festuca idahoensis* and *Poa nevadensis.*

3. Key species *Poa fendleriana, Koeleria cristata,* and *Carex vallicola* on bench marks 8 and 9 on the open grass slopes in the head of Bear Creek should be grazed not more than 25 percent. These slopes have soils of sandstone origin and soil trampling damage results when 25 percent utilization of key species is exceeded.

Data to support the above criteria is filed in section 5 of the Bear Creek Allotment Management Plan folder and consists of grazing impact analyses on the bench marks and soil evaluation made in connection with the site analyses.

CHAPTER 70
GRAZING CAPACITY DETERMINATION

Contents

CHAPTER 70

GRAZING CAPACITY DETERMINATION

Grazing capacity is defined in FSM 2212.6 "The grazing capacity of a National Forest or National Grassland is the number of animal unit months the area will support during a specific grazing period over a long period of years while maintaining soil, forage, water, and timber resources in satisfactory condition of fostering improvement of unsatisfactory conditions."

Much range in Region 4 is in unsatisfactory condition. Therefore, in many cases, it is necessary to consider grazing capacity in terms of inducing improvement of both forage conditions and soil stability through natural means. [redacted] capacity must be based on the current condition of the range and the system of management being applied or upon management practices that are to be adapted immediately. The next step is to plan for increased forage production on primary range and bring as much secondary range into use as practical through improved range conditions and improved management. A knowledge of range potential is necessary to do this.

Grazing capacity determination will consist of two phases on both cattle and sheep range. First, a tentative capacity will be determined based on production of usable forage on the primary range. Second, proper use determinations will be made for a period of at least three years to allow for production fluctuations due to weather. The findings will be used to firm up the grazing capacity estimates. These proper use determinations will be based upon grazing impact analyses coupled with general observations on the allotment. Proper use will give consideration to the needs and welfare of all the resources and uses on the entire allotment.

71 — DETERMINING TENTATIVE GRAZING CAPACITY. After the field work has been completed and maps are available, steps must be taken to organize the data so that it can be used for planning the management of the allotment.

The first step is the compilation of field data. This consists of acreage determination of the various range classifications and the separation of the data into the necessary categories. The second step is to organize the data for use in determining the tentative grazing capacity and eventually writing the management plans.

71.1 — Compilation of Map Data. After final prints have been received, compute acreages of land in the various classifications. Separate computations should be made for National Forest and alienated land. The following compilation steps are suggested:

1. Use one map for a permanent work map.

2. Where General Land Office survey data is available, obtain acreages for each section within the allotment and pencil them in each section on the work map.

3. Compute acreages for each classification within each section. Make sure that acreages within each section balance with General Land Office acreages.

4. On unsurveyed land the compilation can be made by well-defined drainages or by management units.

5. Show total acreage for each classification within the allotment.

6. More detailed compilation may be needed for recording primary range acreages on the compilation form so that direct transfer of acreages can be made from the compilation form to form R4-2200-24. This is necessary because of different grazing capacities within types. The sample compilation form illustrates a detailed breakdown for the primary range and the conventional type for the rest of the suitability classifications. (See Exhibit 71.1.)

7. Retain record in permanent allotment folder.

ALLOTMENT ANALYSIS COMPILATION SHEET

Forest: Bannock | District: White River | Allotment: Bear Valley Cattle
Compiled by: Paul Smith | Date: 2/10/64 | N. F. Land or Other: National Forest

Suitability Classification	Write-up No.	Type Symbol	T4S R6W			T4S R7W						T5S R4W								
			Sec.29	Sec.30	Sec.31	Sec.23	Sec.24	Sec.25	Sec.26	Sec.35	Sec.36	Sec.4	Sec.5	Sec.6	Sec.7	Sec.8	Sec.9	Sec.17	Sec.18	Total
Primary	F-7	S4 $^{38}/_{28}$	12	2	43															57
	F-8	S4 $^{60}/_{71}$	31	40	45															116
	F-11	S2 $^{80}/_{60}$				65	14	215												294
	F-12	S4 $^{28}/_{36}$					55	70	48	55										228
	F-15	S1 $^{62}/_{50}$										106	71	105	20					302
	F-18	S10 $^{48}/_{55}$										45	10	22	29	23				129
	F-21	S10 $^{50}/_{42}$					110	23	50											183
	F-24	S5 $^{61}/_{46}$				40	45	10												95
Total			43	42	88	105	224	318	98	55		151	81	127	49	23				1404
Secondary		(S) 4F	106	71	105															282
		(S) 10F	45	10	22															77
		(S) 1G				27	29	105	50											211
Total			151	81	127	27	29	105	50											570
Unsuitable—used		U4F			72		28	64	29	90	203	52	102	100	280	333	14	171	162	1700
		U9P										24					73	73		170
		U5F															12			12
		U5P							7	12	27		29					91	10	176
		U4V						13	5	22	47									87
		U10F						22		34										56
		U10P						60												60
Total					72		28	159	41	158	277	76	131	100	280	333	99	335	172	2261
Unsuitable—not used		N9P										109					42	88		239
		N4P	9	170	283	15	36	20	163	15	5	153	107	111	2	4	89	112		1294
		N5P			59			38			15		22			5	83	43	224	489
		N6P		15	12	27			83	78					15				55	285
		N9F															43			43
		N5G									106		5				116			227
		N10G								15										15
		N4F								75	83						47			205
		N5F									45		97	23		35	99			299
		N3P									69									69
Total			9	185	354	42	36	58	246	183	323	262	231	134	17	44	519	243	279	3165
Nonrange		7 & 8				23			132	62			180	142	26	67	12	10	10	664
Section Total			203	308	641	197	317	640	567	458	600	489	623	503	372	467	630	588	461	8064

R-4-2200-9 (5/64)

71.2 — Tabulating Data for Determining Tentative Grazing Capacity. All information used for determining the tentative grazing capacity is tabulated on form R4-2200-24. (See Exhibit 71.2-A.) This information is brought together from the number of sources within the framework of the range analysis job. Steps in filling out form R4-2200-24 and determining tentative grazing capacity are as follows:

1. Record the type writeup number as it appears on the site (form R4-2200-13 or 14) and ocular (form R4-2200-10) analysis sheets and the aerial photos.

2. Record type symbols in the second column. These are found on the site and ocular analysis sheets but are also present on the aerial photo and completed range map.

3. Record acreage of the typed area within the management unit in the third or "A" column. This information will be obtained from the compilation sheet (Exhibit 71.1) and from the work map used in compilation.

4. Record dry weight production per acre of "D" (Desirables) and "I" (Intermediates in the "B" column. Ordinarily the "D" and "I" plants will make up the bulk of the vegetation that qualifies as forage; hence, they will generally form the basis for tentative grazing capacity determination. The exception will be when nonforage plants occur in quantity in either of the "D" or "I" classifications. In these instances the production weight of the nonforage plant will be deducted. Nonforage species that may be important are *Artemisia tridentata* on summer range, *Ceanothus velutinus*, and *Arctostaphylos patula.*

5. Record proper use of key species in column "C". This information would come from the proper use criteria. (See Chapter 60, Section 63, Exhibit 63.)

6. Determine and record the utilization rate of the total forage in column "D". This information is determined by use of the "Forage Utilization Guide." (See Exhibit 71.2-B.)

7. In column "E" compute and record usable forage per acre. This is done by multiplying the total dry weight production of "D" and "I" plants by the utilization rate of total forage (D x B = E) to obtain dry weight production of usable forage per acre.

8. Compute and record the determined cow (or sheep) days per acre tentative stocking rate in column "F". This is obtained by dividing the usable forage per acre by the dry weight allowance per cow or sheep day. (See Exhibit 71.2-C for dry weight allowance.)

9. Compute and record tentative grazing capacities in cow or sheep days. This information results from multiplying the number of acres within the typed area by the number of cow or sheep days per acre — (A x F = G).

TENTATIVE CAPACITY
EXISTING MANAGEMENT SYSTEM

Sheep and Cattle

Range Condition Numerical Rating	Utilization of Key Species	Percent Utilization of Total Forage D&I Plants
81 - 100 = Excellent	60%	37%
61 - 80 = Good	55%	33%
41 - 60 = Fair	50%	29%
21 - 40 = Poor	45%	24%
20 or less = Very Poor	40%	20%

TENTATIVE CAPACITY
REST-ROTATION MANAGEMENT SYSTEM

Numerical Rating	Cattle Utilization of Available D&I Plants		Sheep Utilization of Available D&I Plants
	Brush & Timber Type	Meadow & Grass Type	
81 - 100 = Excellent	55%	65%	40%
61 - 80 = Good	50%	60%	35%
41 - 60 = Fair	45%	55%	30%
21 - 40 = Poor	40%	50%	25%
20 or less = Very Poor	35%	45%	22%

Exhibit 71.2-A

TENTATIVE GRAZING CAPACITY

UNIT	ALLOTMENT	FOREST	RANGER DISTRICT
Fall Creek	Meadow Valley C&H	Bannock	Indian Head
CLASS OF STOCK	GRAZING OPERATION	DRY WEIGHT ALLOWANCE	
Cattle	Cow and calf	35 pounds per day	

Write-up No.	Type Symbol	A No. of Acres	B Dry Wt. Prod. per Acre of D&I Plants (Lbs.)	C Proper Use of Key Spec. (Percent)	D Util. of Total Forage (Percent)	E Usable Forage per A. Dry Weight E=BxD (Lbs.)	*F ..... Days per Acre	**G Capacity in ..... Days G=AxF
J2	S4 $^{55}/_{50}$	38	852	40	22	187	5.3	201
J5	S4 $^{38}/_{45}$	48	695	40	22	153	4.4	211
J6	S4 $^{60}/_{55}$	125	1,050	40	22	231	6.6	825
J10	S1 $^{30}/_{25}$	62	525	40	22	116	3.3	205
TOTAL	xx	273	xxx	xx	xx	xxx	xxx	1,442

*Cow or sheep (fill in the class of livestock that applies) days per acre is determined by dividing the usable forage per acre (column E) by the daily dry weight consumption of the animals involved. In the example, a 24-pound consumption was used.

**Fill in the kind of livestock in blank space provided.

R4-2200-24 (7/64)

Exhibit 71.2-B

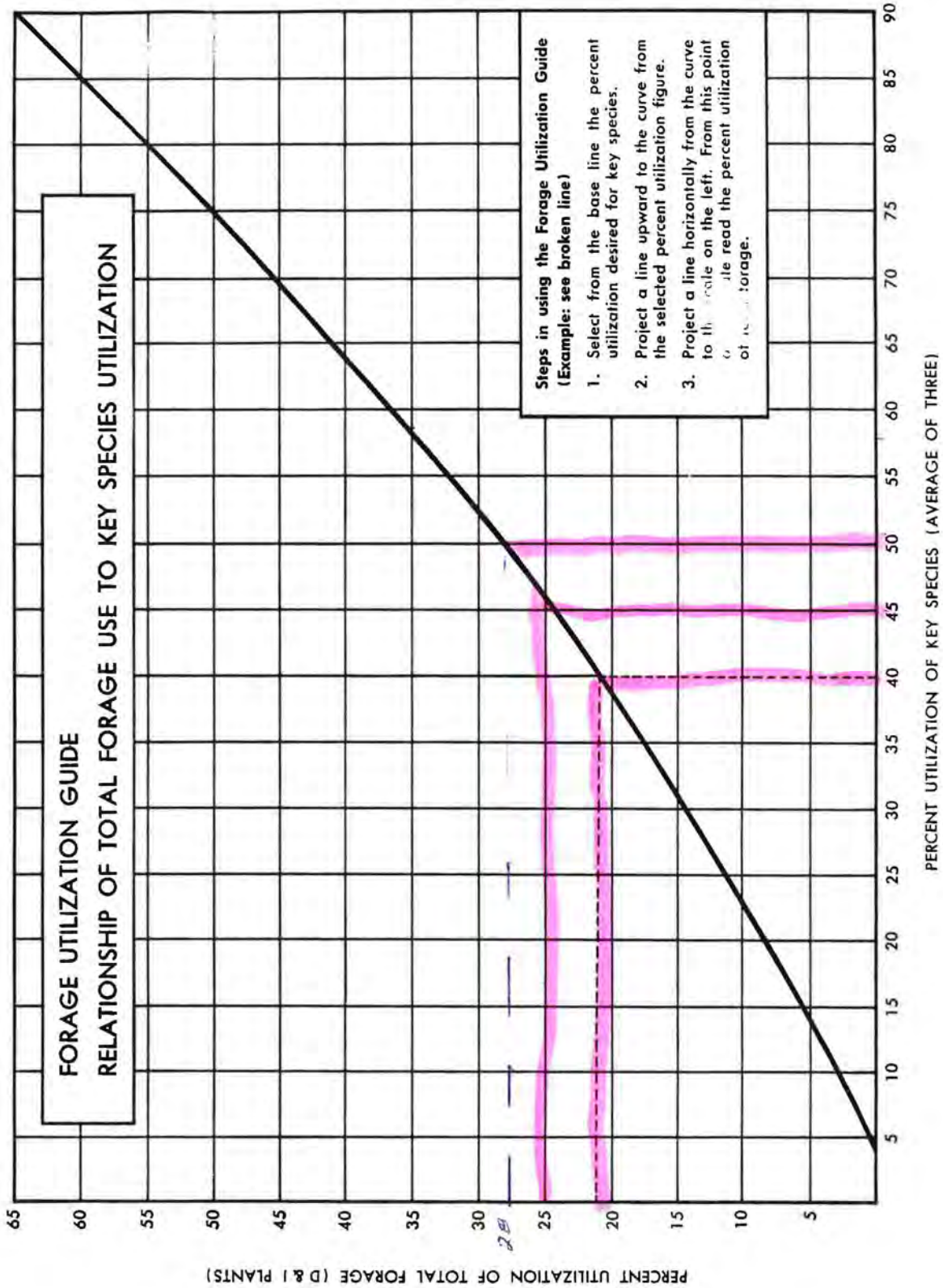


Exhibit 71.2-C

DRY WEIGHT ALLOWANCE

1. Forage consumption table for cattle.

Cattle	Animal Unit Factor	Daily Dry Weight Consumption
1,000-lb. animal	1.00	24
Dry cow	1.00	24
Cow plus 300-lb. calf	1.36	33
Cow plus 400-lb. calf	1.46	35
Cow plus 500-lb. calf	1.55	37
Yearling	.74	18

2. Forage consumption table for sheep.

Sheep	Sheep Unit Factor	Daily Dry Weight Consumption
125-lb. ewe	1.0	4.1
Ewe plus 30 to 40-lb. lamb	1.3	5.3
Ewe plus 40 to 50-lb. lamb	1.4	5.7
Ewe plus 50 to 60-lb. lamb	1.5	6.2
Ewe plus 60 to 70-lb. lamb	1.6	6.6
Ewe plus 70 to 80-lb. lamb	1.65	6.8
Ewe plus 80 to 90-lb. lamb	1.7	7.0
Ewe plus 90 to 100-lb lamb	1.8	7.4
Ewe plus 100 to 110-lb. lamb	1.9	7.8

71.3 — Forage Allowance for Big Game. Where analysis findings show that forage use by big game is an important factor within types or areas of the primary range, it will be necessary to make allowances for this use in determining tentative grazing capacity for livestock. On most summer ranges the big game animals are well scattered or they may be confined generally to the unsuitable portions of the range. In these cases allowances need not be made. However, where competition is serious, administrative decisions will have to be made as to the assignment of the available forage.

72 — FIRMING UP GRAZING CAPACITY.

72.1 — Cattle Range.

1. *Firming up Grazing Capacity Estimates.* Grazing capacity estimates will be firmed up by checking dates of proper use over at least a 3-year period. The bench marks on the allotment will be checked each year to determine the date that proper use is reached. This should be done as near the date of proper use as possible. This information will be coupled with general observations made over the entire allotment in firming up grazing capacity.

On large cattle allotments containing numerous bench marks, grazing impact analyses can be made on one-third of the bench marks within a management unit each year. Those bench marks on which the impact analyses are made will be selected by drawing numbers. New drawings should be made annually. For each bench mark sampled, a minimum of 30 plots will be taken. After impact analyses are made on one-third of the bench marks, an ocular estimate of utilization and impact will be made on the balance.

2. *Recording and Interpreting Proper Use Determinations.* Proper use data may be tabulated as follows:

Date: August 20

Bench Mark	(a) Utilization %	(b) Proper Util. %	Under [1]10%	(c) % of Proper Util.	Over 10%
1. Main Canyon	26	30	√	87	
2. Birch Creek	31	30		103	
3. Left Fork	36	30		120	√
4. Job's Basin	28	30		93	
5. Dry Fork	24	30	√	80	
Average				97%	

$$\frac{a}{b} \times 100 = c$$

[1]Place check (√) mark in the "Under 10%" column if utilization is 10 percent or more below proper use and check the "Over 10%" column if use is 10 percent or more above proper use. In the above [illegible] the average use is about 3 percent under proper utilization and the "Under 10[illegible] column has two check marks compared to one for the "Over 10%" column. T[illegible] ndicates a slightly under-utilized unit. It also indicates that distribution could [illegible]mproved. If these observations were made

on August 20 and the grazing season was June 1 to September 20, it indicates that proper use would be reached in about three more days which would be August 23. This indicates that, in this particular year, the allotment is approximately 30 percent overstocked.

3. *Determine Capacity by Individual Management Units.* Grazing capacity will be determined separately for each management unit on the allotment. For example, where the spring and summer ranges are grazed as separate units, a proper use date will be determined for each. Should 500 cattle enter the spring unit on June 1 and proper use on this unit be reached on June 20 (this is indicated by the grazing impact analyses on the bench marks and observations on the units), then the capacity (for that year) would be approximately 333 cow months. If the same cattle enter the summer range unit on July 1, and the date of proper use is determined to be August 25, the capacity of the unit (for that year) would be approximately 933 cow months. The combined capacity of the two units of the allotment in this case would be 1,266 cow months for that year.

72.2 — Sheep Range.

1. *Management Unit Inspection.* After a sheep allotment has been analyzed and a tentative grazing capacity determined, yearly inspections of the allotment will be made unit by unit. These yearly inspections will follow grazing use and will be supplemented by grazing impact analyses on the more important grazing sites. These inspections will note use intensity and use patterns. Band days use of the suitable range will be determined and band days of overuse or underuse estimated.

2. *Recording and Interpreting Proper Use Determinations.* A table similar to the following will be used to summarize proper use data on sheep allotments. Any use of unsuitable range will be estimated and listed in the "Excess Use" column. Where areas of suitable range have been missed or lightly grazed, an estimate will be made of the band days lost and will be balanced against overused portions within the unit.

Example

Allotment: Camp Creek Year: 1960 Average forage production: 90% Date once-over grazing attained: 9/15 Average weight lambs: 75 lbs. Permitted number: 1,150 S.M.: 3,450 No. grazed: Ewes 1,130, Lambs 1,300

Mgmt. Unit	Planned B.D. Use	Actual Use-B.D.	[1]Excess Use-B.D.	[2]Under Use B.D.	Proper Use B.D.
1	20	23	5	-	18
2	21	18	4	-	14
3	18	17	4	-	13
4	17	16	5	-	11
5	16	18	-	3	21
	92	92	xx	xx	77

[1]Use of the unsuitable range should be shown in this column in addition to excessive use of suitable range.

[2]Show in this column band days net under use of suitable range within the unit. Subtract the band days excess use from the actual use column and add the band days of under use to the same column.

The type of management operation must be considered in firming up carrying capacity on sheep range. An early lamb operation where the lambs are shipped after one month of a three-month grazing season would be different than a late lamb operation where the lambs remain in the herd until the end of the permitted grazing season.

73 — FURTHER CONSIDERATION OF GRAZING CAPACITY ESTIMATES. FSM 2212.6 states: "Although grazing capacity estimates will be used as guides to rates of stocking, they will not be considered as static figures. Estimates will be periodically reviewed and adjusted as required to bring them into line with changing conditions. Forage production may fluctuate considerably from year to year because of weather variations. Consequently, stocking rates established from estimates of production should allow a safety margin to provide for low-forage-producing years." The quality of management also has a marked effect on grazing capacity. Under good management the maximum use can be made of the grazing resource. Under poor management there is a resource loss to both the operator and the public.

74 — POTENTIAL CAPACITY. The possibility of increasing grazing capacity through improved management, fences, water developments, seeding, application of herbicides, or the increased use of secondary range should be recognized and noted during the analysis. These determinations will reflect in the planning and development program for the allotment. The spread between the present production and potential as indicated by the soil depth and quality is a useful guide for determining the potential of an allotment.

75 — PERMANENT PRODUCTION TRANSECTS. Permanent production transects are installed and maintained to note yearly fluctuation in forage production. Even in the more humid mountain areas, forage production may fluctuate as much as 100 percent between years of favorable and unfavorable growing conditions. For this reason, two or three strategically located production transects per Ranger District are very useful in correlating yearly proper use studies.

75.1 — Layout Transect. Twenty 9.6 square-foot plots are located equidistant along a transect line. The center of each plot is marked with a steel peg. Vegetation should be fairly uniform throughout the transect.

75.2 — Yearly Records. Each year at a definite stage of vegetal development, a production estimate is made plot by plot along the transect. No clipping should be done within the plots, but weight units should be developed along the transect to aid in estimation. Use form R4-2200-13 for recording information. Convert all weights from green weight to dry weight.

Suitability Under Rest-Rotation

1. Introduction
2. Factors that effect use pattern on cow range.
   a. Cook's list of the most important factors.
   b. Distance and location from water.
   c. Slope (degree and length).
   d. Aspect of exposure.
   e. Vegetation types.
   f. Climate.
   g. Forage - quantity and quality.
   h. Season of use.
   i. Percentage of range on which use can be expected.
3. Modification of management and its effect on suitability.
4. Percent of mountainous range that can be used.
5. Conclusion and recommendations.

Suitability Under Rest-Rotation

1. Introduction

Cattle naturally overgraze well-watered bottom lands before they move onto sloping lands or areas further away from water (Cook 1967). Cattle will not travel or climb any further than is necessary to obtain food, water, salt, and shade. Only where suitable range has been reduced to depleted condition will cattle locate on rougher portions of the range where feed is still available - (portions of Dixie and Toiyabe). Some areas consist entirely of steep topography, therefore, grazing use would be on steep slopes.

Only steep slopes with the most stable soils (low erodibility index) can stand much grazing use. Except in isolated cases only should we plan to graze such slopes (Salmon River breaks).

In order to more fully understand the problem of range suitability, the grazing habits and factors that effect the pattern of livestock use must be studied. Every area of range is different from every other area; as a consequence the grazing animals react differently. It is, therefore, necessary that each grazing unit be studied so that optomum use can be made after full consideration has been made of the other resources.

Such factors as water, slope, vegetation types, climate, forage and season of use will be discussed. Also, the effect of management modification on the suitability and use pattern.

2. Factors that affect the use pattern of grazing animals (cattle) on mountainous range land.

a. Cook's list of seven most important factors. (Cook, 1966).

(1) Percent of slope to site.

(2) Percent of slope adjacent to water.

(3) Percent of slope from site to water.

(4) Distance to water below.

(5) Percent maximum slope between site and water.

(6) Percent of palatable plants.

(7) Thickness of brush around.

b. Distance and location from water.

(1) The water source is the hub of the grazing activity. Cattle can only use range that can be reached adequately from the water source. An adequate supply of water is the first requirement to consider in planning an intensive management system.

(2) Distance that cows will ordinarily travel in their grazing activity.

(a) Peterson and Woolfolk (1955) found that cattle will travel 2 miles per day under heavy stocking and 1 mile under moderate stocking.

(b) Gonzoles (1964) after a 2-year study found that during normal grazing activities traveled from 1.4 to 4.6 miles per day. In 1961 which was a dry, hot summer, study cows traveled on an average of 2.2 miles per day. During the cool, damp summer of 1962 the study cows traveled on an average of 2.5 miles per day.

(c) Cook (1967) found that when salt was properly located, cattle would travel as much as 3/4 mile from water and

negotiated any short distance slopes as much as 45 percent in between.

(d) Other studies indicate that cattle should not be forced to travel over ½ mile to water on mountainous terrain or over 2½ miles on near level range.

(3) Cattle will work out from the water source on a contour and will make limited use of rather steep slopes.

c. Slope (degree and length)

(1) Julander and Robinette found in Oak Cr. that cattle distribution was definitely limited by steepness of slope.

(2) Gonzoles in his Herd Hollow studies found that slope was second to type in limiting grazing use - section 2.

(3) "Slopes over 45 percent were the least preferred by grazing animals; however, some of these steep slopes were at one side of the main water stream, and they accounted for most of the grazing time recorded for that particular slope." (Gonzoles 1964)

(4) When cattle were allowed to remain along streams and in the bottoms, the forage on adjacent slopes (35 percent or less) was used only 7 percent (Cook-1967).

(5) Herd Hollow study pastures - herd rotated (1963 and 1964) utilization of bottom lands 70 percent. Average use of grasses ranged from 5 to 55 percent - Average 19.4 percent.

(6) Decline in utilization per chain up slope.

10 percent slope - 3.6 percent

30 percent slope - 7.2 percent

50 percent slope - 8.9 percent Phillips

(7) Extremely heavy use in the canyon bottoms did not

materially increase utilization or steep slopes adjacent to canyon bottoms. (Phillips)

(8) Even with herding and judicious use of salt, little utilization can be expected on slope gradients over 20 percent. (Phillips)

(9) Cattle will contour on relatively steep slopes from the water source.

(10) Cattle will not work directly from a canyon bottom onto a steep slope unless forced to do so. (Fences will force them out.)

d. Aspect of exposure.

(1) The relation of aspect to grazing use is not always consistant. Gonzoles in his Herd Hollow study found that cattle used the north exposure a little more than the east exposure, but twice the rate on the south and four times the rate of the west exposures.

(2) Lewis (1936) in studying sheep grazing habits on the Minidoka Forest (Now Sawtooth) found that sheep preferred the north and east exposures to those of south and west exposures.

(3) A use pattern was determined for a sheep allotment on the Caribou Forest where it was found that the sheep preferred the south and east slopes and refused to make use of the north slope even though it was open timber with a good herbaceous understory.

e. Vegetation types.

(1) Season and weather have a strong influence on use of vegetation types. Following are some examples:

(a) On wet cool summers stock prefer the open areas - not only are they warmer, but the forage will maintain its

high quality (Lush).

(b) Conversely, during dry years, the stock generally prefer the shadier parts of the range because forage maintains its succulence. An exception would be mushroom hunting in timbered areas by sheep.

(2) Cattle preference by type in the Herd Hollow study - use intensity relationship by vegetation type : sage-grass = 3, Aspen = 2, Grass = 8, and Forb (wyethia) = 4. The latter two types are influenced strongly by slope in that they are located on the flat, well-watered portion of the study unit.

(3) Results of proper use determinations shows a preference by cattle for open types such as grass, sage and sagebrush. In comparing openings with aspen cover, bench mark studies showed little or no use in the aspen when heavy use was made of the openings.

f. Climatic changes - (precipitation and temperature).

(1) Suitability is influenced by climatic changes from year to year. In his Herd Hollow study Gonzolez found that cattle used the areas close to water during a dry, warm summer (1961) but spread out over a much larger territory in 1962 when moisture was good and the season cooler.

(2) 1965 was a cool damp year. Studies showed the strong influence of climate on grazing capacity; on some allotments the increase was as much as 50 percent. The cattle spread to all the nooks and corners of their allotments because of the above average water supply and the cool weather; in fact, some of the proper use dates indicated almost double the normal grazing capacity.

g. Forage - quality and quantity.

(1) In studies of utilization on the Fishlake N.F., it was found that cattle used their first choice forage plant to approximately 60 percent, then used second and third choice plants without further use of the first choice species.

(2) It is very difficult to force sheep to shift from areas of lush high quality to those of lower quality. Cattle also seek out the more fresh, succulent forage if other restricting factors are not present.

(3) When production gets down to a low point (50 pound dry wt. or less) cattle will ordinarily not attempt to graze the sparse forage. Often the most accessible areas are depleted. Cattle will trail considerable distances through such areas, particularly if the water source is located within it.

h. Season of use.

(1) Use patterns of livestock are different at different seasons - during spring and early summer as well as fall, cattle will graze on steeper more open slopes than during the summer. Cattle will often be observed in the fall on 35 or 40 percent slopes after the bottom lands have been heavily grazed.

(2) Vegetation starts early on the south slopes. While the forage is still green and lush, good use can be made of these slopes. Many of the south slopes particularly in the earlier ranges are past their peak by the time livestock are allowed to enter the National Forests. At higher elevations the south slopes may be high productive and suitable.

3. Modification of management and its effect on suitability.

a. Results of Cooks studies in Logan Canyon (Herd Hollow).

(1) Character of study area - Elevation 6,000 - 7,000 ft. elev.
Slope - 5 - 66 percent
Types - Aspen, sage-grass, and mountain brush.

(2) Drifting livestock

(a) When animals were allowed to remain along streams in the bottoms, the forage on the adjacent slopes (35 percent or less) was used only 7 percent.

(b) When the animals were drifted, forage use averaged 27 percent.

(c) Areas adjacent to water where drifting was employed comprised approximately 40 percent of the total range area.

(d) Most of the areas where cattle were drifted had 35 percent slope or less and were adjacent to permanent stream.

(e) Drifting cattle on a 25,000 acre typical mountain range could result in a gain of 1200 cow months or 3.6 additional cow-day per acre. (drift 2 to 4 times per week).

(3) Salt plus drift

(a) Proper salt placement coupled with proper drifting increased carrying capacity 30 percent.

(b) When salt was present, animals traveled as much as 3/4 mile from water and negotiated for a short distance slopes as much as 45 percent is between.

(c) Drifting alone increased the capacity by 20 percent on 40 percent of the total range, and salting in conjunction with drifting increased the capacity of the range by 30 percent on 70 percent of the total range area.

(4) Water development

Additional water is by far the best means of improving the uniformity of range utilization.

(5) Trail Construction

(6) Fences

(a) Fencing mountainous range cross drainages to form pastures of 700 to 1000 acres increased use on all degrees of slope. By placing the division fences across the streams, the cattle were prevented from traveling along drainages and forced onto slopes.

(b) Use of slopes greater than 35 percent were more than doubled as a result of cross fencing - use of moderate slopes was increased only slightly by fencing.

4. Percent of mountainous range that can be used.

a. Herd Hollow Studies (Gonzolez).

(1) 1961 - Mid season - percent not grazed - 76

End of season - percent not grazed - 75

(2) 1962 - Mid season - percent not grazed - 66

End of season - percent not grazed - 50

(3) Percent of allotment under 30 percent slope 62.

(4) Percent of allotment over 30 percent slope 38.

(5) In 1961 the cattle only made use to the equivolent of 40 percent of the range under 30 percent slope.

(6) In 1962 cattle made use of 50 percent of the range while 62 percent of the range was under 30 percent slope.

b. Grantsville C&H allotment - view graff.

c. Box Elder C&H allotment - view graff.

6. Conclusions and Recommendations

a. Each Forest and allotment has its special problems of cattle distribution. This is the reason the development of suitability criteria has been delegated to the Forests and that firming up procedures are necessary.

b. The use pattern (and suitability) is not consistant from season to season. Therefore, continued study is necessary in order to develop the best management system.

c. The information gained from studying use patterns under open range grazing systems and rest-rotation will furnish the necessary information to strengthen the suitability criteria.

d. Under the key area concept of grazing management, grazing use is far from uniform even on areas of moderate topography. If under a rest-rotation system relatively even use of suitable range is obtained, a big increase in grazing capacity will result. This is where the gain is made under the system and not from forcing cattle onto rough, steep slopes.

e. I have never seen fat cattle that had to graze five miles from water or high on 60 percent slopes.

f. The extent that cattle should be forced onto slopes and away from water depends to a considerable extent on the stability of the slopes and the effect on the cattle themselves.

g. Cattle will contour out from water if it happens to be in a favorable location in relation to the slope and will thus make use of fairly steep slopes.

h. Sheep can be herded on slopes up to 65 percent without too much effort. Generally, the condition of the slope determins its suitability.

i. Using a rest-rotation management system on sheep range may make it feasible to use slopes that could not stand grazing every year; however, under ordinary circumstances, no changes in suitability criteria need to be made for sheep ranges.

Herding and Handling Sheep on Open Range

by Moroni A. Smith - Private Printing 1718.

1. "It is essential that the herder have an unlimited amount of patience, to be gentle and kind with the sheep in every move he makes."
2. He must give the sheep sufficient room...it must be fresh feed....
3. Herders must be with sheep when they first leave the bedground in the morning so as to direct their course.
4. "A slight turn or edging at the time the sheep are leaving the bedground or immediately afterwards, will shape the action of the sheep for the day."
5. Edge the herd into a turn slowly - do not force them into an abrupt turn.
6. Forced turning - the sheep get sulky- or will make a full turn and dash for liberty.

SHEEP GRAZING

Herding

1. To produce fat lambs, the herd should have an abundant supply of fresh, succulent feed (also water) and as much freedom as possible.
2. Factors affecting sheep movement and herding
   a. Topography
      (1) Moderate topography best for case of handling
      (2) When sheep leave the shade up place during warm weather, they will tend to graze on the shadier side of the canyon and avoid the open slopes until towards evening.
      (3) Steep abrupt slopes are barriers to a grazing herd. Even moderate slopes will divert the grazing animals.
      (4) Where the topography is near level or gently rolling, the sheep have a tendency to travel more - however, when a herd reaches the upper basins of their allotment, they become more satisfied and will settle down with a problem.
   b. Vegetation types
      (1) It is very difficult to force the sheep to shift from good lush forage to that of lower quality - shifting from forbs to mature grass is an example.
      (2) Sheep will settle down on snowberry range until 40 to 50 percent of the leaves are eaten. Additional use can only be had with force.
      (3) Once over use until the lambs are removed is necessary for maximum lamb production.
      (4) Sheep make good use of aspen range in warm weather. They like to graze in the shade of the aspen in the afternoons after leaving the shade.

SHEEP GRAZING HABITS

1. Sheep are finicky feeders in the morning and choose only a tid-bit of the choicest plants.
2. Sheep will settle down and feed better in the evening and are not nearly as selective in their feed at that time.
3. The less the herder has to do in handling the herd the better the animals thrive.
4. Sheep prefer fresh feed each day. In order to systematically graze an allotment, checks and controls must be enforced by the herder.
5. Open herding results in less travel by the sheep. Grazing in compact herds results in much travel with its accompanying trampling damage and waste of forage.
6. Sheep have a tendency to become nervous if separated from the main herd - even small bunches do not act normally if they remain in an area after the herd passes on.
7. Thick brush acts as a barrier to grazing sheep even though there are some travel ways.

(5) Thick brush act as a strong barier to a grazing herd. Heavy stands of sagebrush, choke cherry or other brush may be entirely unsuitable.

c. Degree of Utilization

(1) Sheep prefer fresh feed each day.

(2) Time elapses will allow the feed to freshen up particularly if there is a rain.

(3) Holding sheep on an area too long (not necessarily excessive grazing) will result in restlessness of the sheep who may cease to fill up.

(4) If use is forced, it will require the herder to tighten up the spread of the herd with resulting trampling damage to the range and adverse effects on the sheep.

d. Weather conditions

(1) During cool or stormy weather the sheep have a tendency to travel. During cold wet storms the animals have to keep on the move to keep warm.

(2) During warm summer days sheep lie around a great deal. They will spend from 9:00 a.m. to 4:00 or 5:00 p.m. lying in the shade. During these times, the sheep begin grazing at daylight and from 4 or 5 o'clock in the evening until dark.

e. Water Distribution

(1) Ideal situation - stream or spring in bottom of every canyon.

(2) It is an advantage to management (and suitability) to pipe water from hillsides to the canyon bottom. It is very difficult to force sheep to use the slopes below the spring or water development. Sheep will not graze down hill in the evenings.

(3) Watering sites should be close enough that excess trailing is not necessary.

(4) Doubling the distance sheep have to travel to water increases the grazing area adjacent to water source four times.

(5) Should not be required to go more than a mile to water.

f. Aspect

(1) On Minidoka sheep preferred North and east slopes to south and west during the summer period.

(2) The hot sun beating down on the south and west slopes is responsible for the choice. Afternoons much warmer than mornings.

(3) Feed is generally more succulent on the cooler aspects (N & E).

(4) Sheep grazing the exposed slopes (S & W) leave the shade late and as a consequence the evening grazing period is cut short.

(5) On west slopes the shorter evening feeding period is compensated to a degree by the longer feeding period in the morning.

g. Degree of Slope

(1) Sheep will not start grazing up a steep hillside if there is an alternative route. Sometime only strong force will get the sheep to pull onto the slopes (60 percent or above).

(2) Sheep travel much slower on steer slopes than on more gentle topography.

(3) It is difficult to get sheep off from steep slopes once they are established. The herd will delay going to water until they are very thirsty. They will then trail (often on a run) off the slope with resulting damage to the range and slopes.

h. Parts of Range Normally Over-Grazed

(1) Because both the herder and the sheep follow this path of least resistance, the most accessible and easily herded parts of the range will be grazed most heavily.

(2) Areas adjacent to water - the further the watering places are apart, the greater the pressure.

(3) Shade up places where shade is not to plentiful. Shading up too often in one place is as bad as bedding.

(4) Sheep prefer the upper half of slopes and ridge tops.

i. Parts Under-Utilized

(1) Small isolated corners.

(2) Slopes cut after isolated by rocks or brush.

(3) Lower part of long slopes.

(4) Slopes below available water.

(5) Steep, rough country.

Adjustment of Total Pounds Production to Forage Production For Working Up Tentative Capacities

Ref.: 2209.21 Range Environmental Analysis Handbook
Chapter 70, page 71.2-1 Item No. 4

Dry Weight
Poor - Not used
Fair - 50% of weight
Good - Use all weigh

FORBS

Botanical Name	Common Name	Grazing Merit 1/		
		Cattle	Sheep	Horses
Achillea millefolium	Western yarrow	poor fair	poor fair	worthless
Aconitum spp.	Columbia monkshood	poor	poor	poor
Agastache urticifolia	Nettleleaf horsemint	fair	good	fair
Agoseris spp.	Mountain dandelion	poor	good	poor
Allium spp.	Onion	good	good	fair
Anaphalis	Pearl everlasting	poor	poor	poor
Antennaria	Pussytoes	poor	fair	poor
Apocynum	Dogbane	poor	poor	poor
Arenaria	Sandwort	worthless	poor	
Arnica cordifolia	Heartleaf arnica	poor	fair	poor
Aster spp.	Asters	poor fair	poor fair	poor
Balsamorhiza	Balsamroot	fair	good	fair
Calamagrostis rubescens	Pinegrass	poor	poor	
Caltha leptosepala	Marshmarigold	poor	poor	poor
Carex	Sedges	good	good	
Castilleja	Indian paintbrush	fair	fair	
Clematises	Virginsbower	poor	good	poor
Crepis	Hawksbeard	fair	good	
Delphinium spp.	Larkspur	poor	good	poor
Epilobium angustifolium	Fireweed	poor	good	fair

1/ Range Plant Handbook, Forest Service, USDA

Adjustment of Total Pounds Production to Forage Production For Working Up Tentative Capacities

Ref.: 2209.21 Range Environmental Analysis Handbook
Chapter 70, page 71.2-1 Item No. 4

Dry Weight
Poor - Not used
Fair - 50% of weigh
Good - Use all air

FORBS

Botanical Name	Common Name	Grazing Merit 1/		
		Cattle	Sheep	Horses
Eriogonum	Buckwheat	poor	fair	
Frasera	Frasera	fair	good	
Galium	Bedstraw	poor	fair	
Gentiana	Gentian	poor	fair	
Geranium	Geranium	poor	fair	
Helianthella uniflora	1-Flowered sunflower	fair	good	
Lithospermum	Gromwell, stoneseed	fair	fair	
Lomatium dissectum	Carrotleaf	fair	good	
Lupinus spp.	Lupines	poor	poor	poor
Mentha	Mint	fair	fair	poor
Paeonia brownii	Peony	fair	good	fair
Pentstemon spp.	Pentstemon	poor	poor	poor
Phlox	Phlox	fair	fair	
Plantago	Plantain	fair	good	fair
Polemonium	Polemonium	poor	fair	
Polygonum	Knotweeds	poor	fair	
Potentilla spp.	Cinquefoil	fair	fair	
Prenanthes	Rattlesnake root	poor	fair	
Pteridium aquilinum	Western bracken	poor	poor	poor
s parviflorus	Thimbleberry	poor	fair	poor

1/ Range Plant Handbook, Forest Service, USDA

Adjustment of Total Pounds Production to Forage Production For Working Up Tentative Capacities

Ref.: 2209.21 Range Environmental Analysis Handbook
Chapter 70, page 71.2-1 Item No. 4

Dry Weight
Poor - Not used
Fair - 50% of weight
Good - Use all weigh

FORBS

Botanical Name	Common Name	Grazing Merit 1/		
		Cattle	Sheep	Horses
Rudbeckia occidentalis	Western coneflower	poor	poor fair	poor
Sedum spp.	Stonecrop	poor	poor	poor
Senecio serra	Sawtooth butterweed	good	good	poor
Solidago	Goldenrod	poor	poor	poor
Taraxacum officinale	Common dandelion	good	good	good
Thalictrum	Meadow rue	poor	fair	
Thermopsis	Golden pea (Buck bean)	worthless	poor	
Tragopogon	Goatsbeard, salsify	fair	fair	
Valeriana spp.	Valerian	fair	good	
Veratrum californicum	Falsehellebore	poor	poor	poor
Verbascum	Mullein	poor	fair	
Wyethia spp.	Mules-ears	fair	good	fair

1/ Range Plant Handbook, Forest Service, USDA

Abb H. Taylor
Range Conservati
September 17, 19

Adjustment of Total Pounds Production to Forage Production For Working Up Tentative Capacities

Ref.: 2209.21 Range Environmental Analysis Handbook
Chapter 70, page 71.2-1 Item No. 4

Dry Weight
Poor - Not used
Fair - 50% of weigh
Good - Use all wei

SHRUBS

Botanical Name	Common Name	Grazing Merit 1/		
		Cattle	Sheep	Horses
Acer glabrum	Rockymountain maple	poor	fair	poor
Alnus spp.	Alders	poor	poor	poor
Amelanchier alnifolia	Common serviceberry	fair	good	fair
Artemisia tridentata 2/	Big sagebrush	poor	fair	poor
Berberis repens	Low oregongrape	worthless	worthless	worthless
Ceanothus sanguineus	Redstem ceanothus	fair	fair	fair
Ceanothus velutinus	Snowbrush	worthless	poor	worthless
Chimaphila umbellata	Common pipsissewa	poor	poor	poor
Chrysothamnus nauseous	Rubber rabbitbrush	poor	poor	poor
Cornus spp.	Dogwood	poor	poor	poor
Crataegus douglasii	Black hawthorn	poor	poor	
Eriogonums	Buckwheat	poor to worthless	poor to worthless	poor
Holodiscus discolor	Creambush oceanspray	poor	fair	poor
Lonicera spp.	Honeysuckle	worthless	poor	worthless
Pachistima myrsinites	Myrtle boxwood	poor	poor	poor
Philadelphia lewisii	Mockorange	poor	poor	
Phlox	Phlox	fair	fair	
Physocarpus malvaceus	Ninebark	poor	fair	poor
Populus tremuloides	Western aspen	fair	good	fair
Potentilla spp.	Cinquefoil	fair	fair	fair

1/ Range Plant Handbook, Forest Service, USDA

2/ Not important on summer range.

Adjustment of Total Pounds Production to Forage Production For Working Up Tentative Capacities

Ref.: 2209.21 Range Environmental Analysis Handbook
Chapter 70, page 71.2-1 Item No. 4

Dry Weight
Poor - Not used
Fair - 50% of weig
Good - Use all weig

SHRUBS

Botanical Name	Common Name	Grazing Merit 1/		
		Cattle	Sheep	Horses
Prunus emarginata	Bitter cherry	poor	fair	poor
Prunus virginiana	Western chokecherry	poor	fair	poor
Ribes spp.	Gooseberry, currant	poor	fair	poor
Rosa spp.	Roses	poor	fair	poor
Rubus	Blackberry	fair	good	fair
Rubus parviflorus	Thimbleberry	worthless	fair	worthless
Salix spp.	Willow	good	good	good
Sambucus	Elderberry	fair	good	fair
Sorbus spp.	Mountain-ash	poor	fair	poor
Spiraea	Spireas	worthless	worthless	worthless
Symphoricarpos spp.	Snowberry	poor	fair	worthless
Vaccinium membranaceum	Big huckleberry	worthless	fair	worthless

1/ Range Plant Handbook, Forest Service, USDA

Abb H. Taylor
Range Conservationist
March 14, 1969

Adjustment of Dry Weight Browse Species on [redacted]
Summer Range when Working up Tentative Capacities

Dry Weight
Poor - Not used
Fair - 50% of weight
Good - Use all weight

Botanical Name	Common Name	Grazing Merit		
		Cattle	Sheep	Horses
Acer glabrum	Rocky Mt. Maple	Poor	Fair	Poor
Alnus spp.	Alders	Poor	Poor	Poor
Amelanchier alnifolia	Common serviceberry	Fair	Good	Fair
Artemisia Tridentata 1/	Big Sagebrush	Fair	Fair	Poor
Ceanothus Velutinus	Snow brush	Worthless	Poor	Worthless
Ceanothus Sanguineus	Red stem ceanothus	Fair	Fair	Fair
Chrysothamnus Nauseous	Rubber rabbit brush	Poor	Poor	Poor
Cornus spp.	Dogwood	Poor	Poor	Poor
Potentilla spp.	Cinquefoil	Fair	Fair	Fair
Ribes spp.	Gooseberry	Poor	Fair	Poor
Lonicera spp.	Honeysuckle	Worthless	Poor	Worthless
Berberis repens	Oregon grape	Worthless	Worthless	Worthless
Physocarpus maluaceus	Nine Bark	Poor	Fair	Poor
Populus Tremuloides	Western Aspen	Fair	Good	Fair
Prunus Virginiana	Western Chokecherry	Poor	Fair	Poor
Prunus emarginata	Bitter Cherry	Poor	Fair	Poor
Rosa spp.	Roses	Poor	Fair	Poor
Rubus	Blackberry	Fair	Good	Fair
Salix spp.	Willow	Good	Good	Good
Sambucus	Elder	Fair	Good	Fair
Holodiscus discolor	Ocean spray	Poor	Fair	Poor
Spiraea	Spireas	Worthless	Worthless	Worthless
Symphoricarpos spp.	Snowberries	Poor	Fair	Worthless
Vaccinium membranaceum	Whortleberry Huckleberry	Worthless	Fair	Worthless
Sorbus spp.	Mountain Ash	Poor	Fair	Poor
Chimaphila umbellata	Chimaphila	Poor	Poor	Poor
Pachistima myrsinites	Myrtle boxwood	Poor	Poor	Poor
Eriogonums	Buckwheat	Poor to Worthless	Poor to Fair	Poor

Alnus

Poor

1/Not important on summer range

Abb H. Taylor
Range Conservationist
March 14, 1969

Adjustment of Dry Weight Browse Species on Cattle
Summer Range when Working up Tentative Capacities

Dry Weight
Poor - Not used
Fair - 50% of weight
Good - Use all weight

Botanical Name	Common Name	Grazing Merit		
		Cattle	Sheep	Horses
CAREX GEYERI	ELK SEDGE	POOR TO GOOD	POOR	FAIR
CALAMAGROSTIS RUBESCENS	PINE GRASS	POOR TO GOOD	POOR	POOR
SIDALCEA CICUTARIA	STORKS BILL	GOOD	GOOD	GOOD
ASTRAGALUS	PEAVINE	FAIR	FAIR	FAIR
RANUNCULUS	BUTTER CUP	POOR	FAIR	POOR
ASTRAGALUS	VETCH	POOR	POOR	POOR

CHAPTER 80
TREND DETERMINATION

Contents

CHAPTER 80
TREND DETERMINATION

Trend is a term used to describe change in either soil or vegetation condition on rangeland. Changes can be either upward or downward in the direction of improvement or deterioration.

The determination of trend is essential to proper management of the range resource. If the trend in condition of both forage cover and soil is progressing steadily upward, the administrator can be assured that present stocking and management is satisfactory. Corrective measures will be needed where either the soil or vegetal resource continues to deteriorate.

Since trend involves changes which occur over a period of time, it is often difficult to determine from general observations. The most accurate method of determining trend is to make periodic measurements on permanently established plots located on selected bench mark areas. Photographs taken under the proper conditions at periodic intervals is another effective means. The rechecking of old studies and establishment of new ones are important parts of the analysis program.

The principal trend studies established in the Region since about 1920 include:

1. Exclosures
2. Meter square quadrats
3. Species plots
4. Browse plots
5. Line intercept transects
6. Photo plot transects
7. 3-Step transects

Other sources of data useful in determining trend are old range survey writeup sheets and old photographs taken on areas that can be relocated.

Each of the above study approaches or procedures is discussed in detail in the following pages.

81 — ESTABLISHING 3-STEP TREND TRANSECTS. After several years of trial, the 3-Step Method for determining trend in condition was adopted in 1951 for Service-wide use. Briefly, the method consists of: (1) collection of data at permanently marked locations, (2) summarization of data from these areas together with determination of current condition and trend, and (3) a pictorial record of vegetation and soil conditions.

The basis for the following instructions for establishing 3-Step Transects is found in the following papers:

1. "A Method for Measuring Trend in Range Condition on National Forest Ranges," by Kenneth W. Parker — Approved October 17, 1951.

2. "Instructions for Measurement and Observations of Vigor, Composition and Browse," by Kenneth W. Parker — Approved October 13, 1953.

Key points in establishing and measuring 3-Step Transects follow.

R-4 RANGE ANALYSIS HANDBOOK

81.1 — Number of 3-Step Transects Per Allotment. The need and the time required to do the job are the two elements to be considered in determining the number of 3-Step Transects to be established on each allotment. Three-Step Transects are costly and time consuming; therefore, the following general guide will be used.

At least one 3-Step Cluster will be established on each allotment regardless of size. On larger allotments at least one 3-Step Cluster will be established per 5,000 acres of suitable range. Each transect cluster should sample only one vegetal type and one condition class. To do otherwise will complicate the study and minimize the value of findings.

81.2 — Location of Transects. Three-Step Transects will be located on selected bench marks within the allotment. Because there will be more bench marks than it will be possible to install 3-Step Transects, great care must be taken in locating these studies where the most value can be received (see Chapter 50, Section 51).

To insure that the 3-Step Transects can be found for subsequent remeasurement, the following will be done:

1. Make a sketch map to "tie down" locations of the cluster and the individual transects that comprise it. Use compass bearings and distances to well-known topographic or cultural features. Wherever possible, use speedometer mileage readings from well-known points to describe cluster locations.

2. Take a general view picture of the study area from an adjacent ridge or other nearby prominent position. Mark on the photo in ink the location of individual transects. This picture must be dated and camera point location well described. The map and general view photo record is a part of the permanent cluster file. (See Exhibit 81.2.)

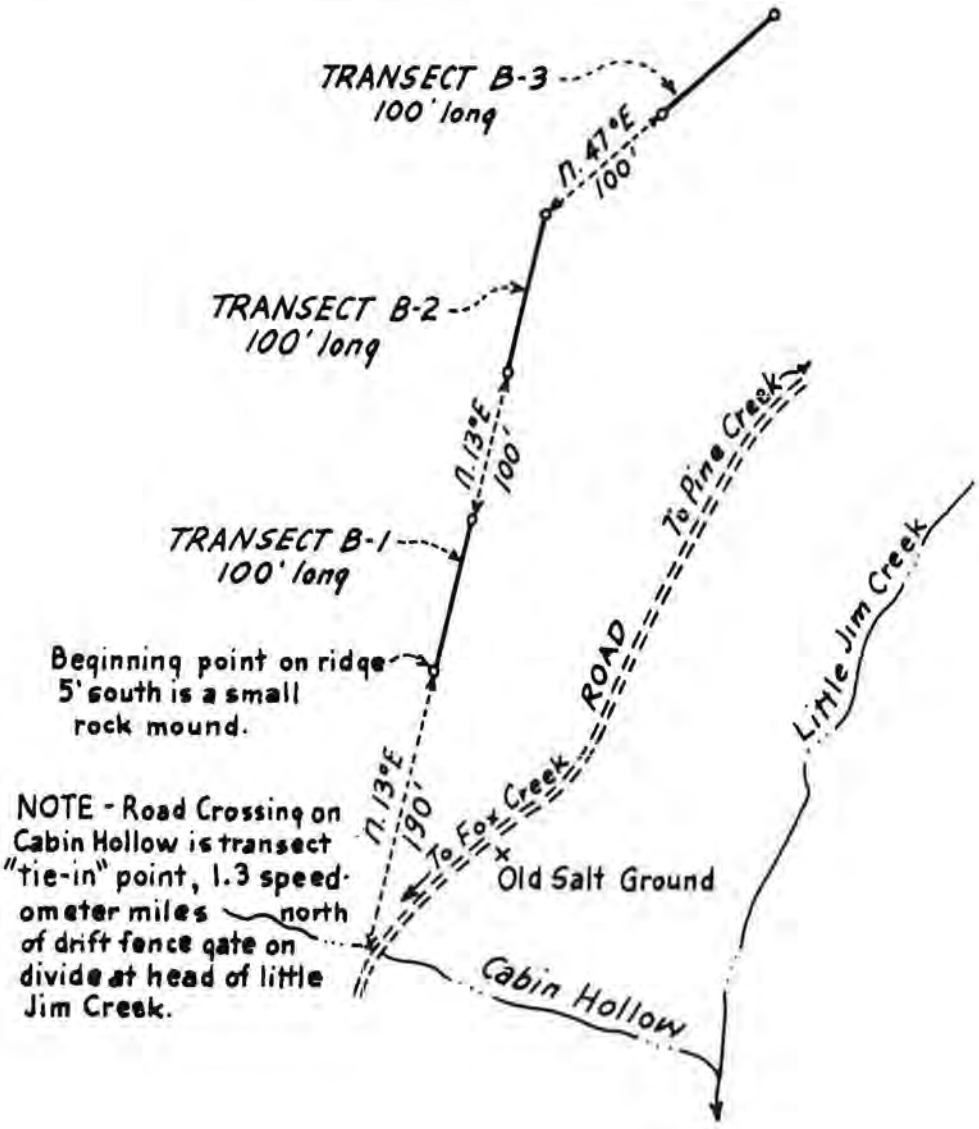
R-4 RANGE ANALYSIS HANDBOOK

Exhibit 81.2

THREE STEP TRANSECT CLUSTER LOCATION MAP

FOREST — Yellow Mountain
RANGER DISTRICT — Williams
ALLOTMENT — Horse Creek C & H
CLUSTER NAME — Little Jim Creek
TRANSECT NUMBERS — B-1, 2 & 3

PREPARED BY — William Smith
DATE — September 1, 1952
SCALE — 1" = 100'



81.3 — Number of Transects Per Cluster. The number of transects in a cluster is governed by the number of "hits" on live perennial vegetation per transect. The following rules apply:

1. If 30 or less hits per transect are obtained — establish 3 transects.
2. If 31 to 60 hits per transect are obtained — establish 2 transects.
3. If 61 or more hits per transect are obtained — establish 1 transect.

81.4 — Length of Transects and Arrangement Within a Cluster.

1. *Length.* The standard length for all 3-Step Transects is 100 feet. There may be exceptions as in narrow stringer meadows or small openings in dense browse types. Here it is permissible to reduce them to 50 or even 25 feet. Regardless of the length, 100 measurements will be recorded. Hit intervals for a 100-foot transect will be 1 foot, 6 inches for a 50-foot transect, and 3 inches for a 25-foot transect.

2. *Arrangement.* Placing transects in a cluster end to end is generally good practice. Another alternative is side by side. In any event, they will not be located closer than 100 feet of each other. Each transect is considered as sampling a plot 150 feet long and 100 feet wide.

Transects should be established parallel to the contour for two reasons:

a. The area sampled will ordinarily be more uniform. There is less chance of getting into a different range use pattern.

b. The job of establishing and measuring transects is easier.

81.5 — Establishment of Permanent Line Transects. The steps in laying out a 100-foot transect line are as follows:

1. *Select a Good Starting Point.* The beginning point and the first 6 or 7 feet of the line should be in the clear to:

a. Facilitate relocating the transect line five or more years hence.

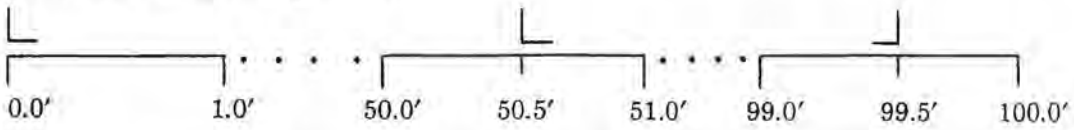
b. So the closeup photo will reveal vegetation, litter, and soil conditions to best advantage.

In seeded areas, grassland, meadow, and forb types, the location of the transect starting point presents no problem. Particular attention must be given to transects which sample sagebrush and browse types.

2. *Stretch the Tape.* Steel rods or iron stakes should be used to anchor the tape at each end. Rods 3½ feet long and ⅝-inch in diameter, sharpened on one end and with an eye in the other, have been used successfully in all vegetal types. To permit adjustment in tape tension, use a small turnbuckle between tape and anchor at the 0.0′ end. At the 100-foot end use a stiff spring 4 to 6 inches long and about one-half inch in diameter. Leather thongs or wire can be used to fasten tape to the rods. Keep the tape as close to the ground as practical. The tape line must be straight.

3. *Drive the Angle Iron Stakes.* These should be 18 to 24 inches long with either a ¾-inch or 1-inch flange. The shorter length is best suited to rocky sites.

a. Place stakes at the 0.0′, 50.5′ and 99.5′ marks along the tape with flanges pointed in the following manner:



b. Stakes should extend about 5 or 6 inches above the ground.

c. Always set the 0.0′ angle iron first. The position of this stake is fixed. A rock or other obstacle may necessitate shifting the starting point a few inches one way or another. When stakes cannot be driven at exactly 50.5′ and 99.5′, shift their location to the closest half-foot mark that the stake can be driven. These positions must be recorded in the appropriate place on form R4-2200-19, Record of Permanent Line Transect.

d. Stakes will be located on the uphill side of the tape.

e. Use a plumb bob to locate the exact stake location when the tape is more than 12 inches from the ground. The plumb bob can be used below this recommended height if desired.

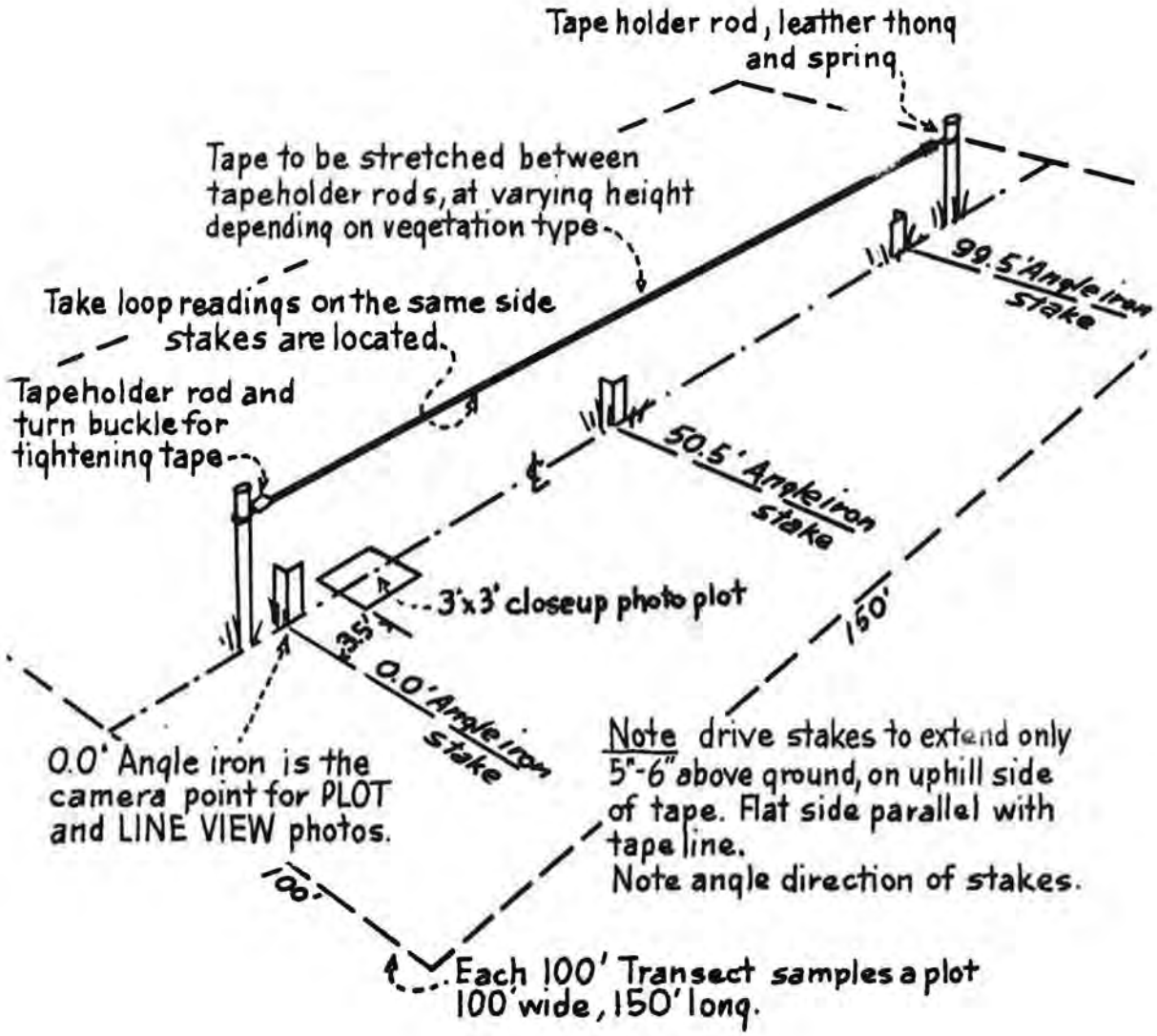
For more details on position of stakes and other transect line information see Exhibit 81.5.

81.5--2

R-4 RANGE ANALYSIS HANDBOOK

Exhibit 81.5

THREE STEP TRANSECT LAYOUT DIAGRAM



81.6 — Photographs. Take the line view and plot pictures before making loop readings. In some vegetational types, the plants will be badly trampled and the value of photos lessened if measurements are made first. Cameras of 4 by 5 inches are preferred for 3-Step Transect work. However, a good quality reflex camera can be used (2¼ x 2½). Photos would have to be enlarged to 4- by 4-inch size. (See Exhibit 81.6 for photo record.)

1. *General Photographic Guides.*

   a. The 0.0′ angle iron is the camera point for closeup and transect line pictures.

   b. Always use a tripod.

   c. Select a camera height that is convenient for ground glass viewing — 50 to 56 inches from ground to base of camera is recommended.

   d. Use the ground glass for focusing and composing both the closeup and general view pictures. Rule of thumb for focusing with 4- by 5-inch camera:

      With lens wide open, focus on a point approximately one-third the distance into the scene to be photographed. Then, for maximum range of sharpness close the diaphragm down to f/16 or f/22.

   e. For best results take pictures when the light is coming from the left or right of the camera (side lighting).

   f. Use a lens hood (sun shade) if available.

   g. Properly identify photographs.

      (1) A small blackboard about 8 by 10 inches with identification symbols in white chalk is recommended for use in the picture. However, the "magic marker" type of ink on white cards is equally good. Ordinary house numbers have also been used successfully.

      (2) Information placed on the blackboard should conform to the identification scheme in use on the individual Forest. Detail should be kept to a minimum.

   h. Photo information will be a part of the permanent transect record. A sample of the form to use is shown as Exhibit 81.6. The photographer will be identified by his full signature. Initials are not adequate.

2. *Instructions for Taking the General View Photo.*

   a. Level the camera.

   b. Center the tape on the ground glass image.

   c. Keep sky area to a minimum (20 percent or less of the picture).

   d. Place the photo identification marker at the 20- to 25-foot mark on the tape.

      (1) Make sure the photo identification marker is about level — in shrub types, keep the front clear of branches.

      (2) Letters and numbers on the identification board should be about 4 inches high in order to show up clearly on prints.

3. *Instructions for Taking the Closeup Plot Photo.*

a. Outline the 3- by 3-foot square plot with a pair of 6-foot folding carpenter rules.

(1) Locate the near side of the plot at the 3.5-foot tape mark.

(2) Center the 18-inch rule marks on the tape.

b. Identify the plot.

(1) Place identification marker outside and at the back of the plot.

c. Level the camera.

d. Center the plot image on the ground glass screen.

R-4 RANGE ANALYSIS HANDBOOK

Exhibit 81.6

3-STEP METHOD FOR MEASURING TREND IN RANGE CONDITION

Photo Record

Forest ..... Ranger District ..... Allotment .....

Cluster name and transect number ..... Date .....

Photo by ..... Camera height (inches) .....

GENERAL VIEW PHOTO

Remarks: .....

CLOSEUP PLOT PHOTO

Remarks: .....

R-4 RANGE ANALYSIS HANDBOOK

81.7 — Reading and Recording Transect Hits. Standardization of ways for reading hits, recording them and compilation of data is essential. Specific instructions follow:

1. *Reading Hits.*

a. Correct Species Identification is Essential.

(1) If plants are not correctly identified, the record of hits will have little or no value for comparison with measurements in the future. Where two individuals work as a team in establishing 3-Step Transects, at least one of them should know all of the common plants.

(2) Do the work before vegetation becomes dried up or too heavily grazed.

b. Readings or observations with the ¾-inch loop are made on the side of the tape where the stakes are located.

c. Proper position of the loop is important in taking readings.

(1) The rod should be suspended in a "plumbed" position with the loop at right angles to the tape.

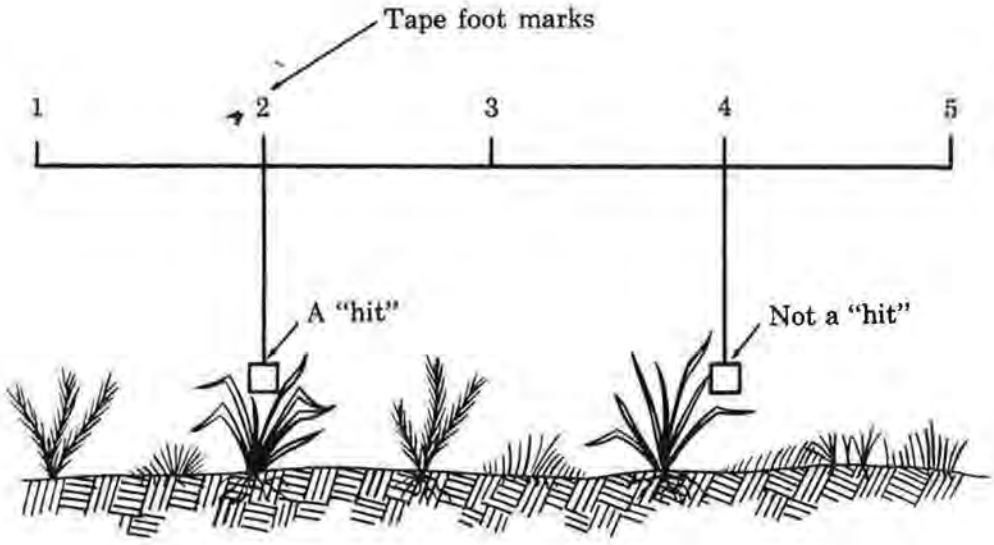
(2) Use of a small plumb bob instead of the loop is recommended where transects sample shrub types or where the tape is more than one foot above the ground. In these situations the following applies:

(a) Plumb bob contact point corresponds to the loop rod position.

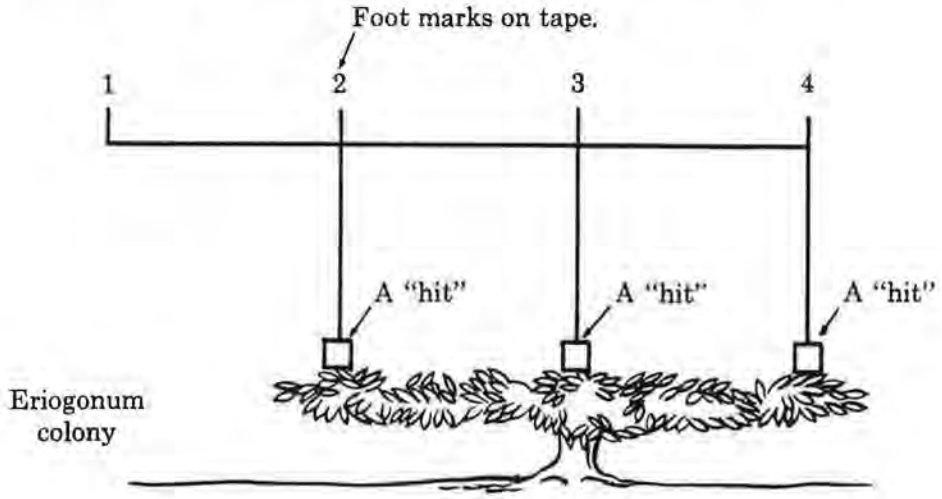
(b) Take reading within the limits of ¾-inch diameter loop.

d. Explanation of Hits.

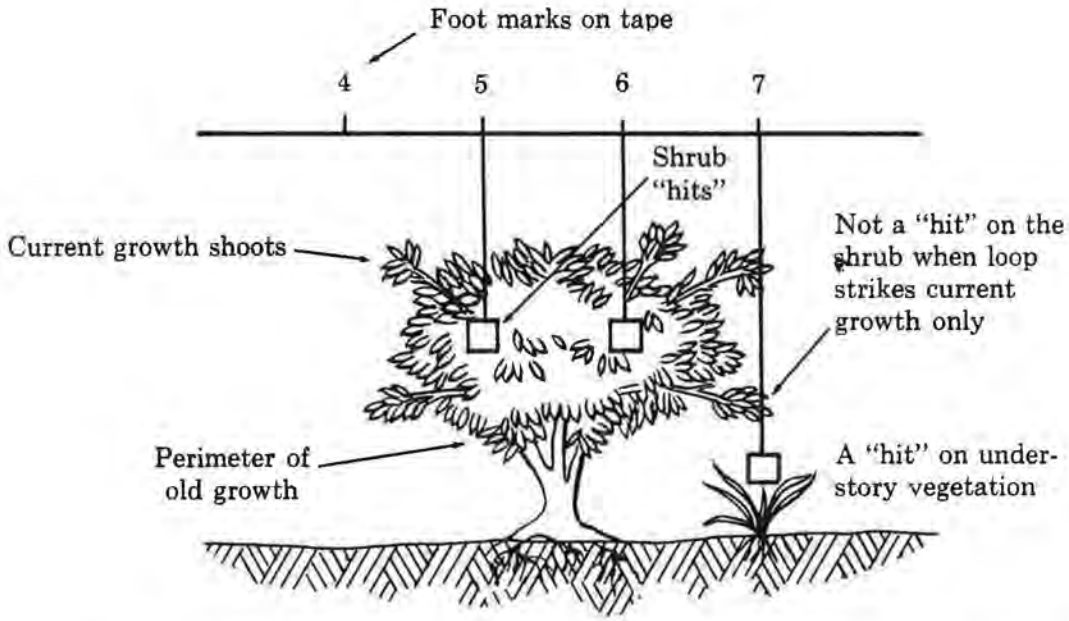
(1) *Perennial Grasses and Grasslike Plants.* A hit is recorded when the live root crown or a part of it falls within the ¾-inch loop. See sketch below. At times there will be two or even three species rooted within the loop area.



(2) *Perennial Forbs.* The same rules apply as for the grasses and grasslike plants. Exceptions are such plants as mat-forming Eriogonums, Antennaria, Phlox, and others. With mat formers, a hit will be noted if the loop strikes anywhere within the crown spread area. See sketch below.



(3) *Shrubs.* A hit will be recorded when the loop strikes any portion of the live plant except current growth. If only current growth is hit, the loop will be extended downward and readings taken of the understory vegetation or other ground surface conditions. The following sketch illustrates this condition.



Hits on dead shrubs or dead branches of living shrubs are discussed under the heading "Recording Hits and Other Information" item 2.

(4) *Annuals.* Hits on annuals are explained under the heading "Recording Hits and Other Information" item 2.

(5) *Litter.* Symbol (L). A hit on litter is recorded when more than half of the area inside the loop is covered with nonliving organic material. Animal droppings are included in this category. Dead plant material will be recorded as litter, only if it was laid down the previous season or before. Debris from current growth does not count. Loop readings on standing dead shrubs are not litter hits. Wood must be on the ground and providing protection to the soil before it can be classed as litter.

(6) *Rock.* Symbol (R). Rock fragments ¾-inch in diameter or larger are classified as rocks. If rock occupies more than half the loop, record as a hit on rock.

(7) *Pavement.* Symbol (P). When more than half the loop is covered with pebbles ⅛-inch to ¾-inch in diameter, the hit will be recorded as pavement.

(8) *Bare Soil.* Symbol (-). This classification includes all soil particles up to ⅛-inch in diameter. The "more than half" rule applies here also.

(9) *Moss.* Symbol (M). Moss also has to occupy over 50 percent of the loop to be counted.

2. *Recording Hits and Other Information.* Plant symbols to use in recording hits are found in the "R-4 Species Lists." (See Chapter 40, Section 41.2, Exhibits 41.21-C and 41.21-D.) The lists include most of the common plants. If symbols are needed for other species apply the following rule:

Use the first two letters of both the genus and species names. Where the genus is known but not the species, use the first three letters of the genus name and add a "z" for species: Example, Carex sp. = Carz.

Hits will be recorded on the "Record of Permanent Line Transect", form R4-2200-19. (See Exhibit 81.7.) Instructions for completing the form are as follows:

a. *Heading.*

(1) "Forest", Ranger District", "Allotment", and "Date" should be largely self-explanatory. Use name of District or name and number (not number alone).

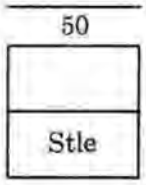
(2) Give bench mark number to transect clusters.

(3) The transect number will be the same as that used on the blackboard to identify line view and plot photographs.

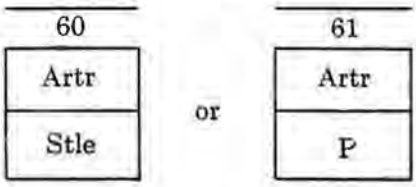
(4) Identity of the worker(s) must be established for present and future needs. They will sign it with their regular signature — not initials.

b. *Record of Hits.*

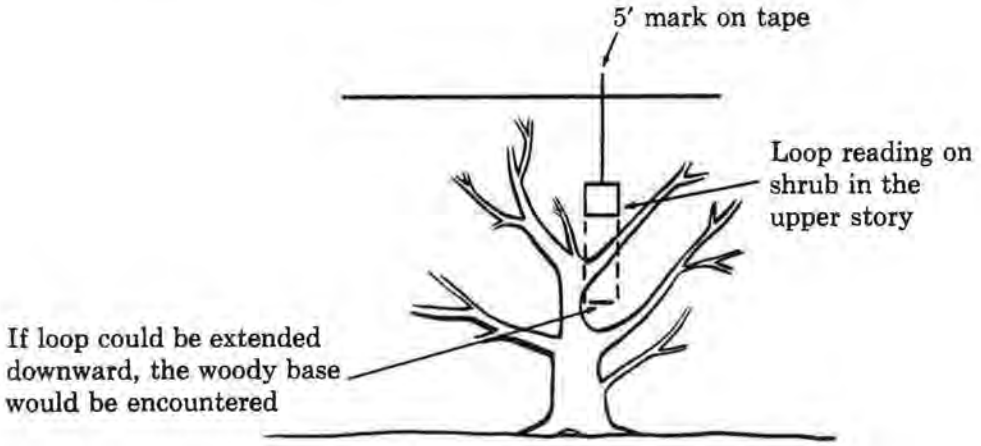
(1) Regardless of the vegetation type sampled, hits on perennial herbaceous vegetation will be shown in the lower half of the block for each foot mark. Example of a hit on Stipa at the 50′ mark:



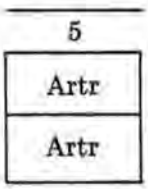
(2) Browse hits are entered in the top half of each foot mark block. Elements of the ground cover or soil are recorded in the lower half, thus:



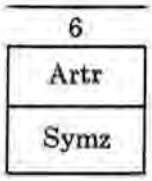
(3) In shrub types there are times when the loop or plumb bob is in a shrub hit scoring position in both the upper and lower story as shown in the following sketch:



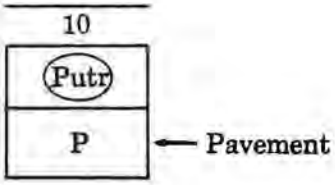
The above situation is recorded in the following manner:



In other cases a hit may be obtained on the upper story of one shrub and on the base of another browse species. This situation would be recorded as follows:

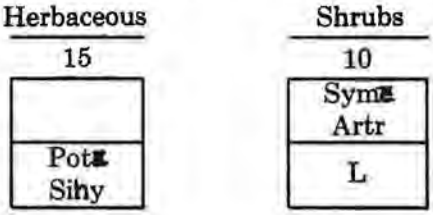


(4) When the loop reading is on a dead branch or shrub the hit is circled in the upper half of the block. The loop is lowered and a record of ground cover is made in the lower half of the block, thus a hit on:



(5) Supplemental information is obtained on all browse hits. Shrubs are classified as to age and form class. See reverse of "Record of Permanent Line Transect" and Chapter 90 on "Big Game Range Analysis" for more details.

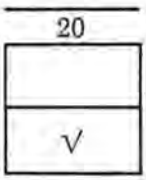
(6) If two species are noted in the same loop reading, record as follows:



(7) Annuals are not recorded in the foot mark blocks. When they occur as the only vegetation within the loop, they are tallied under the heading "Annuals" in the lower right-hand corner of form R4-2200-19. See Section 81.7-2 for explanation.

(a) If the loop falls solely on annuals, the hit will be recorded in the lower part of the block as bare soil, pavement, rock, litter, or moss, whichever item is dominant. These are shown only when there is no perennial live vegetation within the loop.

(8) Grass seedlings of perennial species are indicated by a check (√) mark or other appropriate symbol in the lower part of the block. They are shown in the following manner and identified by a footnote (see bottom of sample form R4-2200-19, Exhibit 81.7).



c. *Key Indicator Species Not Recorded.* Some of the important plants found within the 100- by 150-foot transect plot may not be recorded as hits. It is significant to know they are on the area; list them by genus and species. Include such indicator annuals as *Bromus tectorum* and *Madia glomerata.*

Some of the desirable key indicator species may be rare. If so, indicate by a brief footnote.

d. *Vigor Measurements.* Vigor is a short-time indicator of trend. If grazing intensity is lessened, one of the first responses is improved health of the better grasses. This can be seen where utilization cages have been left in place for at least two seasons or where exclosures have recently been established. Improved vigor shows up in longer leaf lengths and taller, more numerous flower stalks.

Vigor measurements on desirable grasses are of value only where there is a standard with which to compare them. The standard would have to be developed on adjacent comparable range that has been lightly used over a period of years or within exclosures.

For those transect clusters where comparative vigor data can be obtained, proceed as follows:

(1) Record the maximum leaf length on one or two of the better grass species within the 100- by 150-foot macroplot in the following manner:

(a) Select plants at random by pacing.

(b) At the end of each pace take the ungrazed plant nearest the toe and measure the longest basal leaf to the nearest half inch. This should be done until 10 measurements have been recorded for each species.

(c) Total the individual measurements and compute average maximum leaf length.

(2) To secure data for the standard, the longest basal leaf should be measured on a minimum of 50 ungrazed plants.

(a) Use same procedure as outlined under item (b) preceding.

(b) Measurements obtained on the lightly used or protected area should be a part of the permanent cluster record. Include necessary site location information and date leaf lengths were measured.

e. *Tape Height At Stakes.* Tape height is important, especially in the remeasurement of transects in browse types. Record footage location of angle irons along the tape; i.e., 50.5′, etc., and measure and record in inches the height of the tape above the ground at each stake.

f. *Transect Summary Section.* The compilation of the hit record is the final step in the establishment of an individual transect. For details see section "Summarizing the Transect Record", form R4-2200-19, Exhibit 81.7.

g. *Species.* Some of the information called for under this heading concerns compilation. This phase of the record is explained under Section 81.9. Instructions for listing species follow:

(1) As hits are recorded for the different species, list them by symbol and scientific name, symbols alone are not sufficient. Show them in the following manner:

Species	
Feid	Festuca idahoensis
Artr	Artemisia tridentata

(2) The listing of species is a running record. When all 100 hits have been recorded, the tally of symbols and names should also be complete.

(3) Symbol entries in the blocks should be checked with the list at the bottom of the form to make sure there are no omissions.

h. *Pellet Group Count.* See reverse of form R4-2200-19 for specific instructions. Also, see Chapter 90 on "Big Game Range Analysis". Space for recording pellet group counts is included on form R4-2200-19 to make it usable in establishing transects on big game range. On areas where the principal use is by livestock, comparable information is secured by using 1/100-acre circular plots. A more intensive method of sampling is used in connection with the 0.96 square-foot hoop and grazing impact studies. See Chapter 40, Section 41.2, and Chapter 50, Section 53.5-2.

i. *Annuals.* Loop hits on annuals are recorded in the lower right-hand corner of the form. Use a dot-count system for recording.

R-4 RANGE ANALYSIS HANDBOOK

Exhibit 81.7

RECORD OF PERMANENT LINE TRANSECT

CLUSTER NAME AND TRANSECT NO.: Dry Flat – N112

FOREST	RANGER DISTRICT	ALLOTMENT	DATE	BY
Nevada	Willow Butte	Big Creek Cattle	8/9/62	I.N. Mills, L.A. Jackson

1	2	3	4	5	6	7	8	9	10
		Arno	Arno		Artr				Artr
—	L	L	L	L	L	Erra	—	L	L
11	12	13	14	15	16	17	18	19	20
		Symp Putr	Putr						
—	—	—	Putr	Acla	Pofe	—	—	P	R
21	22	23	24	25	26	27	28	29	30
	Putr					Arno			
Antz	Pofe	L	L	L	P	L	—	—	P
31	32	33	34	35	36	37	38	39	40
		Arno	(Putr)			Artr			
L	L	—	Pofe	L	P	L	Antz	Antz	Faid Acla
41	42	43	44	45	46	47	48	49	50
			Symp (Putr)					(Arno)	
P	P	—	Erra	—	L	Antz	P	L	Faid
51	52	53	54	55	56	57	58	59	60
P	—✓	P	Acla	✓	Faid	Pofe Erra	Antz	—	—
61	62	63	64	65	66	67	68	69	70
					Symp	Symp	Symp		
L	Erra	—	—	P	—	L	Faid	Antz	P
71	72	73	74	75	76	77	78	79	80
(Artr)						Arno	Putr		
L	Antz Acla	—	P	P	—	Pofe	Pofe Faid	L	—
81	82	83	84	85	86	87	88	89	90
Arno							Putr (Arno)	Artr	
Antz	Erra	L	P	P	P	—	—	—	Antz
91	92	93	94	95	96	97	98	99	100
	Putr			Symp	Arno				
—	L	M	P	Pofe	L	R	P	—	Faid

KEY INDICATOR SPECIES NOT RECORDED (INCLUDE UNDESIRABLE INVADERS AND ANNUALS)

Lupinus
*Amalanchier alnifolia
Cirsium sp.
Poa secunda
Balsamorhiza sagittata
*Castilleja lemmonii

* very sparse

VIGOR MEASUREMENTS

SPECIES	Pofe	Faid
1	3.0	6.0
2	4.0	7.0
3	6.0	6.0
4	8.5	7.0
5	4.0	5.5
6	4.5	7.0
7	3.0	5.0
8	4.5	5.0
9	2.0	7.0
10	3.0	7.0
TOTAL	42.5	62.5
AX. MAX.	4.2	6.2

TAPE HEIGHT AT STAKES:
0.0' – 11"
50.5' – 13"
99.5' – 9"

	SYMBOL	
BARE SOIL	-	22
EROSION PAVEMENT	P	18
ROCK	R	2
LITTER	L	15
MOSS	M	1
PLANT COVER INDEX		42
TOTAL		100
FORAGE COVER INDEX		34.5
DESIRABLE PLANT INDEX		
GROUND COVER INDEX		78
OVERSTORY		22
UNDERSTORY		8

SPECIES (LIST BY SYMBOL, NAME AND NUMBER OF HITS)

		Hits
Arno	Artemisia nova	4.0
Artr	Artemisia tridentata	4.0
Erra	Eriogonum racemosum	3.5
Symp	Symphoricarpos sp.	5.5
Putr	Purshia tridentata	5.5
Acla	Achillea lanulosa	3.0
Pofe	Poa fendleriana	2.5
Antz	Antennaria sp.	7.5
✓ Faid	Festuca idahoensis	3.5
	Total	42.0

✓ = seedlings

PELLET GROUP COUNT

PLOT SIZE
DEER
ELK
OTHER

ANNUALS (LIST BY SPECIES)

INDICATORS	OTHERS
	Bromus tectorum ☒
	Madia glomerata

OVER

R4-2200-19 (5/64)

R-4 RANGE ANALYSIS HANDBOOK

GENERAL INSTRUCTIONS

List overstory species at the top of each block and circle symbol when it is a dead portion of a living shrub.

AGE CLASSES OF BROWSE PLANTS [1]

S - SEEDLING
Y - YOUNG PLANT
M - MATURE
D - DECADENT

FORM CLASSES OF BROWSE PLANTS [1]

CLASS	
1	ALL AVAILABLE, LITTLE OR NO HEDGING
2	ALL AVAILABLE, MODERATELY HEDGING
3	ALL AVAILABLE, CLOSELY HEDGED
4	LARGELY AVAILABLE, LITTLE OR NO HEDGING
5	LARGELY AVAILABLE, MODERATELY HEDGED
6	LARGELY AVAILABLE, CLOSELY HEDGED
7	MOSTLY UNAVAILABLE
8	UNAVAILABLE

On game ranges classify all browse hits up to 5 feet as M_3, D_6, S_1, Y_2, etc. Tally in block directly behind brose species as "ArtrM_2", etc.

PELLET GROUP COUNTS

Plot size should be 1/100 acre, or a multiple of same, using the tape as the plot center line. Alternative dimensions that may be used are:

WIDTH:	6.6 FEET OR 79.2 INCHES (3.3 FT. EACH SIDE OF TAPE)	OR	6 FEET OR 72 INCHES (3 FT. EACH SIDE OF TAPE)
	AND		AND
LENGTH:	0 TO 66 FT. GIVES 1/100 ACRE		0 TO 72.6 FT. GIVES 1/100 ACRE
	0 TO 99 FT. GIVES 1.5/100 ACRE		0 TO 108.9 FT. GIVER 1.5/100 ACRE

EXAMPLE: A CLUSTER WITH TWO TRANSECTS AND PLOTS 6.6 FEET WIDE AND 0-99 FEET IN LENGTH SAMPLES 3/100 ACRE.

CONVERTING FACTORS:

13 PELLET GROUPS PER DAY FOR DEER
13 PELLET GROUPS PER DAY FOR ELK (TENTATIVE ESTIMATE)
12 DROPPINGS PER DAY FOR CATTLE

NOTES:

[1] Dasmann, Wm. P. Some deer range survey methods. Calif. Fish and Game, Vol. 37, No. 1, Jan. 1951.

DPSU/64

81.8 — Line Intercept Measurement. Line intercept measurements will be made on each transect where browse plants are present. This supplemental information will be recorded while the tape is still in place on each transect (see Chapter 90, Section 93.2).

81.9 — Summarizing The Transect Data.

1. *Summarizing The Transect Record.* The transect record should be summarized in the field. The sheet should be carefully checked for information blank spots before the tape is taken up.

a. *General Rules For Compiling Hits.*

(1) Where there is both an overstory and an understory hit on live vegetation, count only the overstory.

(2) If there is a live overstory hit with bare soil, pavement, rock, litter, or moss underneath, count only the overstory hit.

(3) If there is a dead (circled) overstory hit, with perennial herbaceous vegetation, soil pavement, rock, litter, or moss underneath, count only the understory hit.

(4) Where two species are tallied in either the upper or lower half of a block, each should be given an equal (.5) numerical rating in compiling hits for the transect.

b. *Compilation And Classification Of Hits.*

(1) Following the general rules under the preceding heading, total all hits separately by symbols for bare soil, pavement, rock, litter, and moss.

(a) Where there are no hits on a given item, place a zero (0) in the appropriate space. This will indicate it was not overlooked in the record compilation.

(2) *Plant Cover Index.* Plant cover index is the total of all hits on live desirable, intermediate, and least desirable perennial plants. It should always be determined by actual count rather than from totaling all other items and subtracting from 100. Errors are easily made in adding up the other items. Making an actual tally of live plant hits will be a double check against such errors.

(3) *Forage Cover Index.* Total all live vegetation hits on desirable and intermediate plants.

(4) *Desirable Plant Index.* Total all hits on live plants classified as desirable. The figure will be the desirable plant index for the transect.

(5) *Ground Cover Index.* Subtract hits on bare soil from 100. This is the ground cover index.

(6) *Overstory.* This is the total of all live shrub overstory hits.

(7) *Understory.* This is a total of all hits on understory vegetation occurring beneath live shrub overstory hits.

c. *Compilation of Hits By Species* The hits for individual species within the transect should be totaled and listed at the bottom of the form. The compilation of

hits is shown in the following example:

Specie Symbol	Species	Hits
Erra	Eriogonum racemosum	5.5
Pofe	Poa fendleriana	7.5
Antz	Antennaria sp.	3.0
Stle	Stipa lettermani	6.0
	Total	22.0

The total will agree with the transect "Plant Cover Index" if compilation is correct.

2. *Summarization Data For The Transect Cluster.* Data from the transect cluster will be summarized on form R4-2200-21. (See Exhibit 81.9-A.) All phases of the cluster summary should be done in the field. Most of the work consists of copying and averaging data from the individual "Record of Permanent Line Transect", form R4-2200-19. Each of the various parts of the form is explained as follows:

a. *Heading.* Self-explanatory.

b. *Composition.*

(1) Transfer from the individual transect records, form R4-2200-19, the hits for the principal species. Total all hits on minor species and include under "Other".

(2) Average the hits by species and "Other".

(3) Adjust the hits under the desirability classes according to the species lists. (See Chapter 40, Section 41.21, Exhibits 41.21-C and 41.21-D.) In the sample, "Symz" is listed under both desirable and intermediate, and "Artr" under both intermediate and least desirable. The hits will have to be adjusted to fit the desired percentage in each desirability class. This can be done by use of a percentage factor based on the plant cover index obtained by dividing the plant cover index into 100. In the sample Exhibit 81.9-A, the percentage factor is 2.63 and means that each hit is the equivalent of 2.63 percent. On this basis the hits can be adjusted between the desirability classes on an approximate basis using only units down to one-half a hit.

(4) Determine percentages of each species listed in each desirability class by multiplying the average hits times the percentage factor. For example, "Carz" has a total of 2.5 hits under the "Desirable" classification. Then 2.5 hits times the percentage factor 2.63 equals 6.6 percent. Round off the total percentages when it is transferred to the lower left-hand corner of the form for use in condition rating.

c. *Cluster Summary.* Completing this part of the form is simply a matter of transferring data from the individual transect records, form R4-2200-19, and computing averages.

d. *Vigor Measurements.* The average maximum leaf length of the selected species for each transect will be transferred from form R4-2200-19 and averaged. This average will then be compared with a standard developed by making the same measurements of the same species growing under protection from grazing. This will be expressed in percent of standard and entered in the last column of the vigor measurement table. These comparisons must be made the same year and for similar sites. A point rating will then be made based on the average percentage as shown at

the bottom of the vigor measurement table. Use the "Vigor Standard" in Exhibit 81.9-B to determine the point rating.

e. *Supplemental Information From The Macroplots.* This information is from an area 100 by 150 feet in which each transect occupies the center.

(1) *Current Soil Erosion.* Soil erosion will be classified by the point system as shown in Chapter 40, Section 41.28, Part II of Exhibit 41.28-B.

(2) *Apparent Trend.* Apparent trend will be indicated by arrow for both vegetation and soil stability. Use form R4-2200-25 for this determination which after completion will become a part of the 3-Step Trend record. See Exhibit 41.28-D.

(3) *Dispersion.* Cover dispersion will be judged ocularly based on judgment gained in weight estimate site analysis. See Chapter 40, Section 41.27.

f. *Pellet Groups Or Dropping Count Summary.* Data from each permanent line transect will be recorded in the summary block. See back of form R4-2200-19 for information on plots, and also see Chapter 90, Exhibit 92.6 for table on estimated forage removal.

g. *Range Condition Determination.* From the recorded and summarized information on form R4-2200-21, range condition will be determined by the same procedure as used in site and ocular analysis except that vigor and cover ratings will be used in lieu of production.

(1) *Composition Rating.* Use "Guide for Rating Vegetal Condition," Chapter 40, Section 41.28, Exhibit 41.28-A. (See Exhibits 41J & 41J-1

(2) *Cover Rating.* To obtain the cover rating, subtract the average values of pavement and rock from the ground cover index and determine by use of the appropriate cover rating standard. (See Exhibit 81.9-B.)

(3) *Vigor Rating.* Use the percent of standard in the vigor measurement table and determine the point rating from the "Vigor Standard" portion of Exhibit 81.9-B.

(4) *Forage Condition Rating.* Add (1), (2), and (3).

(5) *Ground Cover Index Rating.* This rating is based on the ground cover index and is determined by use of Exhibit 41.28-B, Part I, Chapter 40, Section 41.28. Exhibit 41K or 41L

(6) *Current Erosion Index.* Copy direct from the table on current soil erosion.

(7) *Soil Condition Rating.* Add (5) and (6).

(8) *Browse Condition and Trend.* See Chapter 90, Section 93.3 and Chapter 40, Section 41.28-2.

h. *Special Grazing Impact Determinations.* Wherever 3-Step Transect Clusters are established, it is essential that annual measurements of grazing impact be made. This is necessary for the proper interpretation of 3-Step data. If regular grazing impact analyses have not been made, a separate impact analysis can be tied directly to the 3-Step Transect by setting up a 100-foot tape on the transect and making utilization and other checks along the tape at 10-foot intervals. The plots should be centered at the 5-, 15-, 25-, etc., foot marks on the tape. See Chapter 50 for guides in making grazing impact analysis.

R-4 RANGE ANALYSIS HANDBOOK

This Summary Form is out of date

Exhibit 81.9-A

SUMMARY OF TRANSECT CLUSTER

Use R4-2200-21 (3/64) form for Summaries

FOREST	RANGER DISTRICT	CLUSTER NAME AND TRANSECT NO.	
Fish Lake	Mountain View	Mill Canyon FZ01, FZ02	
HERD UNIT	ALLOTMENT	EXAMINER	DATE
—	Sinks C+H	D.R. Williams A. Anderson	7/15/62

COMPOSITION

DESIRABLE		AV. % OF TOTAL PLANT HITS Av. Hits	Percent	INTERMEDIATE		AV. % OF TOTAL PLANT HITS Av. Hits	Percent	LEAST DESIRABLE		AV. % OF TOTAL PLANT HITS Av. Hits	Percent
Carz 5.0	—	2.5	6.6	Symz .5	.5	.5	1.3	Chna 16.5	3.0	9.8	25.8
Pofe —	5.0	2.5	6.6	Stte 4.0	3.0	3.5	9.2	Artr 4.5	5.0	4.7	12.4
Symz 3.5	4.5	4.0	10.5	Spco 2.0	—	1.0	2.6	Antz —	4.0	2.0	5.3
Agsm 1.0	—	.5	1.3	Artr 3.0	4.0	3.5	9.2	Other 1.0	—	.5	1.3
Other —	1.0	.5	1.3	Other 2.0	3.0	2.5	6.6				
TOTAL			26.3	TOTAL			28.9	TOTAL			44.8

VIGOR MEASUREMENTS

SPECIES	TRANSECTS 1	2	3	AVERAGE Av.	* %
Pofe	2.9	2.9		2.9	83
Carz	6.0	5.3		5.6	80
				Av.	82

* % of the standard

CURRENT SOIL EROSION

	POINTS
1. NONE	
2. SLIGHT	
3. MODERATE	25
4. ADVANCED	
5. SEVERE	

APPARENT TREND

VEG. ↓

SOIL ↓

PLANT DISPERION:

UNIF.____ FAIRLY UNIF. ✓ VAR.____ HIGHLY VAR.____

CLUSTER SUMMARY

(SYMBOL)		TRANSECTS 1	2	3	AVERAGE
BARE SOIL	-	47	33		40
EROSION PAVEMENT	P	3	26		14.5
ROCK	R				
LITTER	L	7	8		7.5
MOSS	M				
PLANT COVER INDEX		43	33		38
TOTAL		100	100	100	
FORAGE COVER INDEX		21	21		21
DESIRABLE PLANT INDEX		95	105		10
GROUND COVER INDEX		53	67		60
OVERSTORY		28	18		23
UNDERSTORY		1	1		1

% DESIRABLE 26

% INTERMEDIATE 29

% LEAST DESIRABLE 45

PELLET GROUPS OR DROPPING COUNT SUMMARY

	TRANSECTS 1	2	3	AV.	EST. FORAGE REMOVAL/AC.
PLOT AREA (AC.)				1/100	
COW DROPPINGS	2	1		1.5	249
SHEEP PELLETS					
DEER PELLETS	3	4		3.5	120
ELK PELLETS					

CONDITION RATING:

COMPOSITION RATING 14

COVER RATING 9

VIGOR RATING 9

FORAGE CONDITION RATING 32

GROUND COVER INDEX rating: 20

CURRENT EROSION INDEX 25

SOIL CONDITION RATING 45

BROWSE: CONDITION G APPARENT TREND →

R4-2200-21 (5/64)

Exhibit 81.9-B

STANDARDS FOR COVER AND VIGOR

Cover Standards — Based on 25 out of 100 points.

General Standards

% Cover*	Point Rating
85 - 100	21 - 25
65 - 84	16 - 20
50 - 64	11 - 15
25 - 49	6 - 10
0 - 24	0 - 5

Standards for Alpine and Meadows

% Cover*	Point Rating
95 - 100	21 - 25
85 - 94	16 - 20
70 - 84	11 - 15
45 - 69	6 - 10
0 - 44	0 - 5

Vigor Standards — Based on 15 out of 100 points.

Leaf Length % of Standard	Point Rating
Over 95	13 - 15
85 - 94	10 - 12
70 - 84	7 - 9
50 - 69	4 - 6
0 - 49	0 - 3

*Cover equals the ground cover index minus rock and pavement.

82 — REMEASUREMENT OF 3-STEP TRANSECTS. Knowledge of trend is essential in proper management of the range. Therefore, periodic measurements of permanently established plots are an important part of the range job.

Three-Step Transects should be remeasured at intervals of 5 or more years. Unless drastic changes in management have been put into force, measurements at shorter intervals may show little or no change. All steps followed at the time of original establishment will be repeated except placement of stakes.

When transects are remeasured, all previous data should be reviewed. Past use records are also essential for interpretation of the remeasurement data.

During the process of remeasurement, care must be taken to duplicate the details of procedure used in the original establishment of the transects. Previous errors such as those in plant identification should be corrected. Due to recent changes made in form R4-2200-21 (summary form) it will be necessary to resummarize the data from past transect records, form R4-2200-19, on the latest summary form in order to make comparisons.

Direct comparisons between the photographs and numerical changes in condition as determined on the summary sheet will furnish the basis for determining the trend.

83 — PHOTO PLOT TRANSECTS. Photo plot transects for determination of range trend originated in Region 4 in 1943. The method which combined photographs and sketching vegetation on permanent plots was developed jointly by administrative and research personnel.

Installation of photo plot transects ended in 1951. Followup measurements are being made and will continue as an active program. Field remeasurements, analysis of data, and reports of findings will hereafter be handled by Forest personnel.

Key points for establishing and recording photo plot transect data follow:

1. Transects are located on key parts of the range.

2. Five to twelve 3- by 3-foot plots are located at mechanically determined intervals of 100 to 300 feet along a compass course.

3. Each plot is permanently marked.

4. One or more general view photos are taken along the transect to further tie down the location of the study.

5. Plots are photographed from permanently marked camera points.

6. Several photos are taken along the transect line to illustrate specific vegetation and soil conditions such as hedged browse, active gullies, and invasion by inferior plant species.

7. A sketch map, on which perennial plants are charted, is made for each plot.

8. Litter and erosion conditions are observed and recorded in detail, plot by plot.

9. A brief description is written about vegetation and erosion conditions on the sampled area. These notes have proven to be a valuble addition to the plot records.

Photo plot transect records are being used in making administrative decisions on adjustment in grazing use. Photographs are effective in showing visible evidence of trend in vegetation or soil. Transects provide a record of longtime ecological changes. The longer the photo plot studies are continued, the more significant is the story they tell. Present practice is to recheck the plots at five- to eight-year intervals.

84 — OTHER ESTABLISHED TREND STUDIES.

84.1 — Exclosures. Fenced plots are helpful in studying trend. They provide a good means of evaluating site potential and showing rate of recovery under protection from grazing. They are also good demonstration areas for selling the importance of good range practices and proper stocking to the general public.

During the twenties and early thirties, hundreds of small exclosures were established throughout the Region. The majority were only one rod square. In 1939, most of them were abandoned as they were considered to be too small. Many turned out to be nothing more than rodent concentration areas.

Since 1940, it has been regional policy to fence at least one acre in each new exclosure. Some of the smaller exclosures which were not abandoned, as well as larger ones established since, can provide range technicians with important clues to changes which are taking place. These exclosures should be maintained and studied carefully.

84.2 — Quadrats. Some 1,200 permanently marked meter-square quadrats were established in the Region, principally in the twenties. This program was closely associated with that of the small exclosures.

Although the quadrat program was discontinued in 1939, some quadrats were recharted in the early forties. The quadrats would have a high value for trend determination. If any of the Forest Supervisors wish to rechart old quadrats, the Division of Range Management will furnish forms and directions for doing the job.

85 — USE OF PHOTOGRAPHS IN DETERMINING TREND.

Good pictures are one of the best mediums for showing trend. Pictorial evidence of change is especially convincing to individuals who are not technically trained. Many opportunities have been and are being overlooked to make use of general view photographs in trend studies work.

Procedures for obtaining trend information on a specific area through the use of photographs follow.

85.1 — Retakes of Old Photos.

1. Old files in Forest Supervisor and District Ranger Offices should be searched for pictures. Grazing inspection, management, supervision, and studies folders are some of the best sources. However, none of the old files should be overlooked.

2. Select those photos that are clear, sharp, and show good detail of conditions on a specific range area. The location and the year and date the picture was taken must be known.

Pictures that include topographic and/or physical features are good since the photo sites can be found readily with a minimum of searching. Photos that show meadows, wil-

lows along creek bottoms on cattle ranges, openings in timber types, gullies, portions of drainage basins or slopes as seen from vantage points are also good ones to consider.

3. Locate approximate point on the ground from which original picture was taken.

4. Establish permanent camera point and retake photo.

a. Use a ground glass camera to insure matching the scene area with that on the original photo.

b. Date and completely describe what the picture shows. A suggested record form is included in Exhibit 85.1. The negative can be filed directly under the picture if corners are used in photo mounting. Otherwise, place in an envelope with adequate identification and staple to back of the photo form.

5. All photo files should be marked "Permanent Record — Do Not Destroy."

R-4 RANGE ANALYSIS HANDBOOK

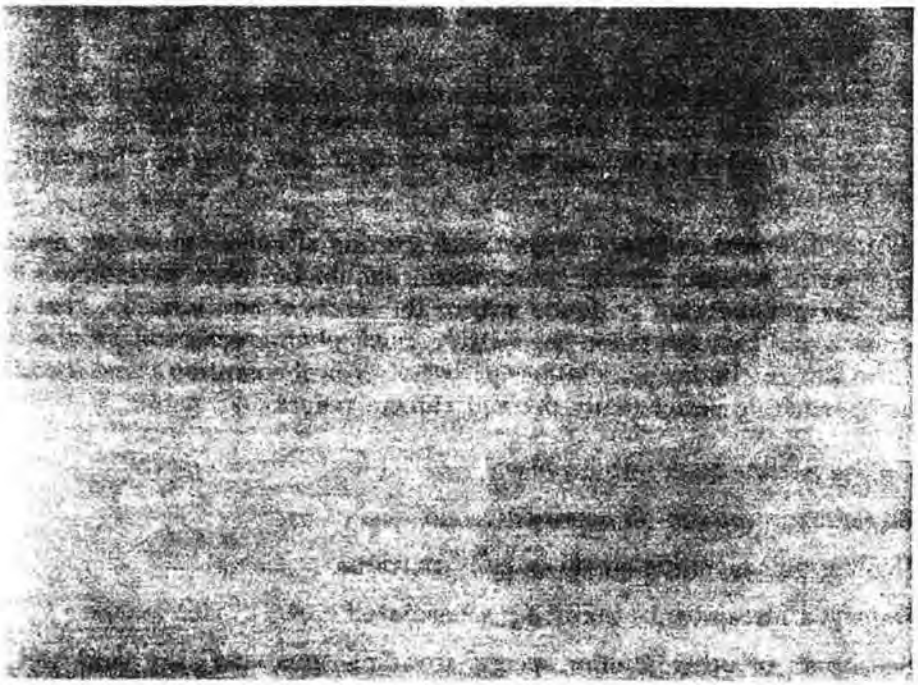
Exhibit 85.1

RANGE PHOTO POINT RECORD

Forest Ranger District Allotment

Photo By Date Hour

Location (brief description)



Notes: (Give brief explanation of purpose of photo, conditions, etc.)

85.2 — Establishment of Permanent Camera Points on Bench Marks. Some type of record is needed on those bench marks where 3-Step Transects are not established. The use of photographs to illustrate conditions and trend offers a fairly rapid yet inexpensive and reliable way to obtain important information.

Permanent camera points should be carefully chosen within a given bench mark. Pictures will have considerable value if their locations are carefully selected and good photographic techniques are followed. The picture sites should be representative of typical conditions. Photographs taken at intervals over a period of years can be useful to illustrate changing patterns in forage utilizations; to indicate changes in the amount and quality of litter protection afforded the soil; and to show important changes in plant composition. If the bench mark area is large it may be desirable to take photographs from more than one permanent camera point. Camera points established should be well marked. A good system is to mark them with a rock mound or an iron stake. The latter should be long enough so they cannot be easily removed. Locations should be carefully plotted on the grazing allotment map. It may also be well to pinpoint them on the back of aerial photos for the allotment.

Permanent camera point photos on bench marks should be well documented in the same manner as retakes of old photos. See Exhibit 85.1 for the pictorial record form to be used. Mark all file folders containing these photographic records, "Permanent Records — Do Not Destroy".

85.3 — Other Camera Points. Within each grazing allotment there are usually a number of situations of which a photographic record should be made at intervals of 5 to 10 years. They may or may not be found within the limits of bench marks. The earlier that sites are chosen and pictures taken the better. Such photographs will be of value now as well as in the future. Following is a partial list of typical condition-trend situations which can be illustrated from permanently marked camera points.

1. Gullies cutting back into meadows.
2. Streambank erosion on overused range.
3. Healing gullies, either single or gully patterns.
4. Damaged streambanks becoming revegetated.
5. Sagebrush or other inferior species invading grassland, dry and wet meadows, seeded areas, or other forage types.
6. Areas to be seeded or sprayed are to be followed with later photos showing grass stand establishment.
7. Medium closeup scenes of important range areas where forage cover is depleted or poor and marked changes have recently been made in management and stocking. Photos will be important to show rate and degree of recovery.
8. Hedged and highlined willows on cattle range.
9. Longtime ecological changes such as:
    a. Timber species invading meadows, sagebrush, or other types.
    b. Grasses beginning to dominate areas now covered with sagebrush.
10. Watershed areas before and after terracing.

The same care should be taken in obtaining these photographs as with the retakes of old pictures and those to be obtained on bench marks. See Exhibit 85.1 for the pictorial record form to be used. All file folders containing this data will be marked "Permanent Records — Do Not Destroy".

86 — RECHECKING OLD RANGE SURVEYS. Between about 1915 and 1950 range surveys were made on parts or all of most of the National Forests in Region 4. Some areas were covered twice and in a few instances three times.

Some of the old type maps and survey writeup sheets have been destroyed, others are still available. They may be stored in basements, warehouses, old barns, or similar places. A search should be made to see if any of the old inventory data can be found. Rechecks of old surveys may reveal valuable trend information. Changes in species composition and invasion of types by better or inferior plants will show up if the resurvey was done to a high standard. Rechecking should be limited to the smaller types. There is too much chance for error if broad types are sampled.

Individuals who have had range survey training will get more value from old range survey data; however, they will serve as a valuable trend indicator to any range technician. The following general rules should apply in doing the field work.

1. Use of the sample plot technique is recommended in obtaining a cross section of plant composition.

   a. Record composition on 10 to 20, 1/100-acre circular plots in inventorying a type.

   b. Average the percentages and adjust figures based on judgment of overall type composition conditions.

2. First, make estimates of the percent of the total plant cover made up of each class of vegetation; i.e., grasses-grasslike plants, forbs, and shrubs, on each plot selected at random by pacing.

3. In breaking down plant composition by species, do not record estimates under five percent or a multiple thereof; exception — species of particular indicator value that may not occupy five percent of total cover. Then make estimates of one, two, three, or four percent as the case may be.

When field work has been completed, the writeups can be compared directly with earlier data for effective trend information. The percentages can be summarized by types. Findings can be effectively presented in the form of condensed tables, bar graphs, or pie charts.

R-4 RANGE ANALYSIS HANDBOOK

CHAPTER 90

BIG-GAME RANGE ANALYSIS

Contents

CHAPTER 90

BIG-GAME RANGE ANALYSIS

The big-game range analysis instructions for Region 4 have been revised to include up-to-date techniques and procedures to correlate them more closely with range analysis procedures and to bring analysis instructions in accord with Service-wide standards. These instructions supersede "Big Game Range Analysis" of February 1954.

Instructions should be followed as closely as possible in order to attain uniform Region-wide application. However, there is sufficient latitude to allow individuals to use their initiative to perfect and improve techniques and procedures. If field use brings to light defects in techniques, or if more effective procedures are developed, they should be brought to the attention of the Regional Office for evaluation.

These instructions will be used in conjunction with Range Analysis Instruction, Chapters 1-8 inclusive, and each will supplement the other in providing sound information for management of National Forest rangelands.

91 — OBJECTIVES. All Ranger Districts have a part, or all, of one or more deer herd units, a majority of the Districts have elk herds, and many have other species of big game. Because of this, there is need for an analysis of big-game range in order to correlate big-game use with other resource uses on National Forest land and coordinate all uses under the multiple use concept. Big-game range analysis is a composite of range and big-game surveys to determine range condition and trend, game occurrence, and population trends as a basis for management. Much of the information and data collected in range analysis will be used to supplement data collected in big-game range analysis. Both range analysis procedures are designed to furnish reliable data for development of plans for management of the forage resource.

The principal objective of the big-game range analysis is to recognize and use key areas as a basis for management of big-game range resources. The determination of proper use, the classification as to condition and apparent trend of vegetation and soil, and other studies on key areas will be used to accomplish this objective.

91.1 — Responsibilities. Training of personnel responsible for wildlife habitat management activities is an essential prerequisite for a sound program.

Responsibilities for training and collecting information in the big-game range analysis program are:

The Regional Office will:

1. Train one or more men on each National Forest in techniques and procedures for conducting the analysis.

2. Develop Regional instructions in accordance with Service-wide standards and policies.

3. Keep abreast of improved techniques and procedures developed so they can be incorporated into the Regional instructions.

4. Revise the Regional instructions when necessary to incorporate improved and up-to-date techniques and procedures.

5. Establish cooperative agreements with the states.

The Forest Supervisor will:

1. Train District Rangers, Assistant District Rangers, and others working on big-game range anlysis.

2. Inspect to assure that techniques and procedures are followed.

3. Submit suggestions to improve techniques and procedures.

4. Cooperate with State Fish and Game Departments and land management agencies interested in big-game habitat management.

The District Ranger will:

1. Make certain that personnel working on big-game range analysis are qualified and well trained.

2. Cooperate with other Rangers, personnel of State Fish and Game Department, other land management agency personnel, and Forest Supervisor in making studies for big-game range analysis.

3. Make studies on the District and gather information and data needed for big-game habitat management plans.

4. Submit suggestions for improvement in techniques and procedures.

91.2 — Cooperation. Cooperation with personnel of the State Fish and Game Departments and land management agencies is essential in most phases of the big-game range analysis program because of interrelated responsibilities. Where they are concerned, their advice and cooperation should be sought in developing big-game habitat management plans. Active cooperative participation should be secured at the start of the analysis and progress through to its completion. It is also desirable to obtain sportsman and livestock permittee participation whenever possible. A better understanding of the problems, objectives, and desirable action will result if these people and others concerned are familiar with and participate in the analysis and studies.

Priorities for starting the analysis on herd units should be cooperatively established, where possible, with the personnel of other agencies involved. Obtaining the best factual records for all land within a herd unit will, in many cases require cooperation and exchange of information with these agencies.

92 — BIG-GAME RANGE ANALYSIS PROCEDURE

92.1— Minimum Requirements. The minimum requirements for big-game range analysis consists of the following:

1. Herd unit map 1"-2" = 1 mile
2. Designation of herd unit boundaries. Use Idaho Big Game Map

3. Delineation of seasonal use range.

4. Designation of key areas.

5. Establishment of studies on key areas.

a. Condition and trend classification will be determined for each key area. This to be done following instructions outlined in FSH 2212.01.

b. Long-term condition and trend. To include one or more of the following:

(1) Parker 3-Step Transect

(2) Line intercept transect

(3) Fenced exclosure

(4) Photo point transect

c. Impact studies. To include one or more of the following:

(1) Browse utilization transect

(2) Impact studies comparable to those made on livestock ranges

(3) Utilization cages

(4) Trampling impact

(5) Soil compaction

d. Animal use studies. To include one or more of the following:

(1) Pellet group counts

(2) Track counts

(3) Bed ground counts

The data collected from the studies will be used in the analysis and as a basis for preparing the biological unit management plan for the big-game herd unit.

92.2 — Maps and Mapping. Private lands or lands of other public agencies, either inside or outside the forest boundary, which constitute part of the herd unit, will be included in the herd unit map.

Private lands that are within key areas will be mapped the same as National Forest lands. Studies will not be conducted on such lands without agreement with the landowner and as a cooperative program with the State Fish and Game Department.

A large-scale map, preferably on a 2″ = 1 mile scale, will be used. For large herd units, maps of 1″ = 1 mile are acceptable. This large-scale map is to show (1) herd unit boundary, (2) seasonal use range, (3) key areas, (4) vegetative type and condition classification, and (5) location of other studies. Items 3 through 5 are for key areas only.

R-4 RANGE ANALYSIS HANDBOOK

Exhibit 92.2

LEGEND

Forest ..... District..... Herd Unit .....

Date..... By.....

Herd Unit Boundaries

A solid black line 2 to 6 inches between symbol:

Mule deer	D
Black-tail deer	B
White-tail deer	W
Elk	E
Moose	M
Antelope	A
Bighorn sheep	S
Mountain Goat	G

Migration Routes 

Key Area Boundary

1/16" dashed line .....

Seasonal Use Boundary

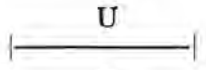
A line broken at ½-inch intervals:

Winter	red
Intermediate	light green
Summer	yellow
Yearlong	purple
Waste or non-range	uncolored

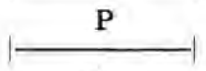
Key Area Letter and Number K-1

Key area letter and number shown in center of area determined to by key.

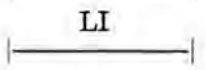
Study Designation



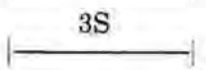
Browse utilization



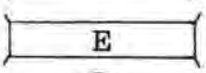
Pellet group transect



Line intercept



Parker 3-Step

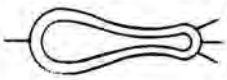


Exclosure

Camera point

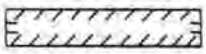
X—X—X Fence


Water development


Reservoir


Spring

Quadrant


Private land


Rehabilitation area

Condition Numerical Rating

81-100—excellent
61-80 —good
41-60 —fair
21-40 —poor
20 or less—very poor

Trend

↑—up ↓—down →—not apparent

Range Condition and Trend

64↓ Vegetation condition good, trend down
42→ Soil condition fair, no apparent trend

Browse Condition and Trend

G, B↓—Browse condition good, trend down

Aerial photographs may be used to record the basic field information and analysis on key areas. The data may be transferred from them to the large-scale map. Preparatory work on aerial photos to be used on key big-game areas will be done in accordance with Range Analysis instructions.

Where more area than one Ranger District is involved, personnel will correlate the maps and data. Symbols on standard legend (Exhibit 92.2) will be used for all items shown on basic maps and aerial photographs.

92.21 — Herd Units. The herd unit which encompasses the yearlong range of each species of big game is the basic area in big-game habitat management planning. Herd units have been determined by game and land managers in some states. If the boundaries of the herd unit have not been determined, valuable information can be obtained from State Fish and Game personnel and District personnel with several years tenure who have knowledge of the movement of big-game herds and the area used by them at various seasons of the year. Information can also be gained from checking station records and records regarding trapping, tagging, and transplanting big-game animals. Cooperation is needed in this task and every effort should be made to obtain the best information possible.

After the herd unit boundaries have been determined, forms R4 2600-6 (Exhibit 92.21), 2600-10, 2600-11, 2600-12, 2600-13 (Exhibits 92.21 - A, B, C, D) Herd Unit Analysis will be filled out as completely as possible.

HERD UNIT ANALYSIS
Exhibit 92.21

Forest..... RangerDistrict .....Date.....

Herd Unit .....

Land Area and Approximate Ownership

Square Miles	Summer		Intermediate		Winter		Yearlong		Total	
Acreage										
Land Ownership	*Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Forest Service										
BLM										
Private										
State										
Fish & Game Dept.										
Indian Service										
Other										
Totals		100		100		100		100		100

Key Area Record — designated K1, K2, etc., marked on map

Key Area Designation	Season Used	RA Designation Condition & Trend	Major Big-Game Forage Species & Trend	Key to Management
Example K-1	winter	U 4 $\frac{61\rightarrow}{39\downarrow}$	Artr→, Putr↓, Amal↓	Putr
K-1 (cont'd)	winter	S 5 $\frac{42\downarrow}{40\downarrow}$	Putr↑, Samz→, Puvi↑	Putr
Example K-2	summer	S 1 $\frac{48\downarrow}{38\downarrow}$	Chvi↑, Arca→	Area
Example for elk K-1	winter inter-mediate	U 4 $\frac{63\rightarrow}{48\downarrow}$	Putr→, Pope→, Agsp↑	Watershed trampling

R4-2600-6 (6/66)

R-4 RANGE ANALYSIS HANDBOOK

HERD UNIT ANALYSIS
Exhibit 92.21-A

Forest ..... Ranger District ..... Date.....

Herd Unit .....

Herd Unit Trend Count Summary

Name of Counting Unit	Years									
	19	19	19	19	19	19	19	19	19	19
Comparative Totals										

Browse Utilization Transect Trends (Study Transects Marked on Map)

Name & No. of Transect	Years									
	19	19	19	19	19	19	19	19	19	19

HERD UNIT ANALYSIS
Exhibit 92.21-B

Forest ..... Ranger District ..... Date.....

Herd Unit .....

Growth Index (Total growth: total number of twigs)

Name & No. of Transect	Years									
	19	19	19	19	19	19	19	19	19	19

Use Index (growth index X percent utilization)

Name & No. of Transect	Years									
	19	19	19	19	19	19	19	19	19	19

HERD UNIT ANALYSIS
Exhibit 92.21-C

Forest ..... Ranger District ..... Date.....

Herd Unit .....

Pellet Group Count Transect Summary (Study Transects Marked on Map)

Big Game Species										
	Days Use Per Acre									
	19	19	19	19	19	19	19	19	19	19

Forage Removal Per Acre (Study Transects Marked on Map)

Name of Transect	Pounds Air Dry Weight									
	19	19	19	19	19	19	19	19	19	19

R4-2600-12 (6/66)

HERD UNIT ANALYSIS

Forest ..... Ranger District..... Date.....

Herd Unit .....

Herd Unit Kill Summary

Year	Number Hunters	Kill—Regular Either Sex Hunt				Kill—Special Permit Hunt				Number Permits Authorized				Percent Success on Unit	Total Kill on Unit	Remarks
		Bull Buck	Cow Doe	Calf Fawn	Uncl.	Bull Buck	Cow Doe	Calf Fawn	Uncl.	Bull Buck	Cow Doe	Either Sex	Total			
19																
19																
19																
19																
19																
19																
19																
19																
19																
19																

(Note: Attach additional sheets as needed for photo records and summary of other data.)

R4-2600-13 (6/66)

As information from key area studies and other recurrent studies becomes available, it will be added to the summary sheet data.

92.22 — Seasonal Use Areas. Seasonal use areas are portions of the herd unit used by big-game species part of the year or one particular season. Information from local game managers, State Game and Fish Department personnel, and District personnel who have observed big-game movements within the herd unit should be sought prior to fixing seasonal use boundaries. Seasonal use boundaries will be marked on the herd unit map with a black ½" broken line. (Exhibit 92.2).

Seasonal range will be colored in accordance with the standard legend (Exhibit 92.2). Areas over 20 acres that are barren, waste, inaccessible, or unuseable by specific big-game animals will not be colored. Areas that are not accessible during the winter, such as north-facing slopes and drainages where large amounts of snow accumulate making their use impossible, should not be mapped and colored as winter game range.

92.23 — Key Areas. Selection of key range areas is very important and one of the first jobs to be done after the herd unit has been determined. The key areas will be the study units on big-game range.

They may be:

1. The limited portion of the range on which game winter.

2. Concentration sites at any season, such as, but not limited to, fawning, calving, lambing, or kidding areas used in the spring, or meadows used by elk early in the spring.

3. Where dual use by game and livestock is resulting in more than moderate utilization of the principal game forage plants.

Key areas are usually small portions of seasonal range *where proper range use* will insure maintenance of satisfactory conditions, both vegetative and soil, on the remainder of the area.

Key areas will be located and designated on the herd unit map with the letter K and a number such as K-1, K-2, etc.

93 — BIG-GAME RANGE STUDIES ON KEY AREAS. When key game range areas have been determined, a job list is to be compiled in the herd unit folder.

Many of the jobs listed will be a cooperative effort indicating the need for cooperation between the agencies and individuals involved.

In most states, Bureau of Land Management, Forest Service, and Fish and Game Department personnel work together on studies. This type of cooperation is to be encouraged. Where separate studies are maintained, there should be a free exchange of information.

It may also be desirable to invite representatives of sportsmen organizations and livestock permittees when making studies in order that they will better understand the objectives of big-game habitat management.

Because of the difference in key areas, there will be a variation in the number and type of studies needed for management purposes. Four categories of studies are suggested, (1) condition and trend classification, (2) long-term trend, (3) use impact, and (4) intensity of animal use. The decision as to the type and number of studies needed on each key area

will be made by those making the big-game range analysis. However, item (1) is required on all key areas.

In making studies on key areas, reference will be made to plants as being "desirable," "intermediate," or "least desirable."

Two plant lists for shrubs have been prepared: (1) plant species list, Exhibit 41.21, C&D, Chapter 40, R-4 Range Analysis Handbook, and (2) species list, Exhibit 93, Chapter 90, R-4 Range Analysis Handbook.

The two shrub lists are to be used as follows:

1. The plant list, Exhibit 41.21, C&D, Chapter 40, is to be used for doing the range analysis phase (condition and trend classification) of big-game range analysis.

2. The plant list, Exhibit 93, Chapter 90, is to be used for determining condition and trend of browse plants.

The purpose of a separate species list for rating browse condition and trend is that forage values in browse plants tend to be higher for big game than for livestock.

93.1 — 3-Step Transects. Our goal is the establishment of one long-term trend study on each key area. The Parker 3-Step Transect is one method for doing this. They should be placed so they represent typical big-game range conditions. It is desirable to locate clusters inside and outside of study enclosures. These transects will be established in accordance with instructions in Chapter 8, Range Analysis, and data will be recorded on Form R4-2200-19 (Exhibit 81.7).

Parker 3-Step Transects established for game range analysis, should be programmed for measurement in conjunction with the 3-Step for range management.

Concurrent with the recording of data on the transect line, all shrubs and trees with available forage up to five feet, which are hit by the readings, will also be classified as to age and form class. The classification will be tallied in the block directly above the species — Examples: M2 1

Artr utr

Exhibit 93.

Ratings of Browse Plants for Determining Condition and Trend

Symbol		Desirable	Intermediate	Least Desirable
Acez	Acer spp.	0-5	6-10	10+
Alcr	Alnus crispa			x
Alte	A. tenuifolia			x
Amal	Amelanchier alnifolia	0-10	11-20	20+
Ampr	A. prunifolia		0-10	10+
Arcz	Arctostaphylos spp.		x	
Arar	Artemisia arbuscula	0-10	10-20	20+
Arno	A. nova	0-15	16-30	30+
Arca	A. cana	0-10	10-30	30+
Arfr	A. frigida	0-5	6-20	20+
Artr	A. tridentata	0-10	11-30	30+
Artr[2]	A. tripartita	0-10	11-30	30+
Atca	Atriplex canescens	x		
Atco	A. confertifolia		0-5	6+
Bere	Berberis repens	0-5	6-10	10+
Cefe	Ceanothus fendleri		x	
Cegr	C. greggii		x	
Cesa	C. sanguineus	x		
Ceoc	Cercis occidentalis		x	
Ceve	C. velutinus	x		
Cein	Cercocarpus intricatus	x		
Cele	C. ledifolius	x		
Cemo	C. montanus	x		
Cebe	C. beluloides	x		
Chna	Chrysothamnus nauseosus	0-10	10-20	20+
Chvi	C. viscidiflorus		0-5	5+
Cost[2]	Cornus stolonifera		0-5	6+
Cost	Cowania stansburiana	x		
Elaz	Elaeagnus spp.			x
Ephz	Ephedra spp.		0-5	5+
Eula	Eurotia lanata	x		
Gusa	Gutierrezia sarothrae			x
Hodu	Holodiscus dumosus		0-5	5+
Juco	Juniperus communis		0-10	10+
Jusc	J. scopuloreum		0-5	5+
Pamy	Pachistima myrsinites	0-10	10-20	20+
Pera	Peraphyllum ramosissimum			x
Phma	Physocarpus malvaceus		10	11+
Potr	Populus tremuloides	0-10	10	
Prem	Prunus emarginata		0-20	20+
Prfa	P. fasciculata		0-10	10+
Prvi	P. virginiana	0-10	11-20	20+
Putr	Purshia tridentata	x		

Quga	Quercus gambelii	0-5	6-10	10+
Rhal	Rhamnus alnifolis		0-10	10+
Rhbe	R. betulaefolia		0-10	10+
Rhpu	R. purshiana	0-5	6-10	10+
Rhgl	Rhus glabra	0-5	6-10	10+
Rhtr	R. Trilobata		0-5	6+
Ribz	Ribes spp.		0-10	10+
Rosz	Rosa spp.		0-10	10+
Salz	Salix spp.	0-10	11-40	40+
Sagl	Sambucus glauca	x		
Sara	S. racemosa	0-10	11-25	25+
Save	Sarcobatus vermiculatus			5+
Sosc	Sorbus scopulina		0-5	5+
Spiz	Spirea spp.		0-10	10+
Symz	Symphoricarpos spp.	0-10	11-25	25+
Teca	Tetradymia canescens		0-5	5+
Vaez	Vaccinium spp.	x		

The age classes of browse plants are designated as follows:

Seedling — Very young plant, which has become firmly established and yet obviously a newcomer on the range. It is usually distinguished by its relative size, simple branching, and succulent bark.

Young plant — Larger than a seedling with more complex branching and more fibrous bark, but does not show signs of maturity, such as rounding crowns. Juniper poles up to 10 feet are placed in this category.

Mature plant — Complex branching, rounded growth form, larger size, heavier and often gnarled stems. Crown is made up of three-quarters or more of living wood.

Decadent plant — Shrub or tree which is dying from age or other factors. Crown shows one-fourth or more dead wood.

Sample growth ring counts may be helpful.

The form classes for browse plants are numbered from 1 to 8 as follows:

1. All available, little or no hedging.
2. All available, moderately hedged.
3. All available, closely hedged.
4. Largely available, little or no hedging.
5. Largely available, moderately hedged.
6. Largely available, closely hedged.
7. Mostly unavailable.
8. Unavailable.

In conjunction with 3-Step Transects, pellet group counts should be made on a strip plot of 1/100 acre or multiple thereof while the tape is still in place and this information recorded on the form. Details regarding pellet group counts are given on the back of form R4 2200-19 (Chapter 8).

93-2 — Line Intercept Transect. Another type of permanent transect study, useful in supplying reliable trend information, is the line intercept method. This method is adapted to areas where there is considerable browse and consists of establishing transects 100 feet in length and permanently marking them with iron stakes so they can be accurately relocated and measured at five-year intervals. Iron stake will be placed at 0.0′, and 99.5′ — the same as for the 3-Step Transect described in Chapter 8. The height of the tape above the stakes will be recorded.

A record is made on form R4 2600-5, Line Intercept Record (Exhibit 93.2) to the nearest inch of the linear spread of living browse plants by species intercepted by a vertical projection from the transect line. Variations can be made in this study to collect information similar to that obtained from the 3-Step Transect study or only that portion pertaining to browse plants. These transects often indicate a change in condition much sooner than 3-Step Transects.

Photographs may be taken in connection with the line intercept studies using a 4″ x 5″ camera mounted on a tripod. At least two photographs, a line view, and a general area

LINE INTERCEPT RECORD
(Condition and Trend)
Exhibit 93.2

National Forest		Ranger District		Cluster Name		Transect No.		Examiner	Date
Species		Species		Species		Species		Species	
Actual Intercept	Total Inches	Actual Intercept	Total Inches	Actual Intercept	Total Inches	Actual Intercept	Total Inches	Actual Intercept	Total Inches
TOTAL									

For trees and shrubs up to ..... feet above the ground.

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view, may be taken at each line intercept study. More photographs may be taken if deemed desirable to depict various conditions on the area near the intercept study. All photographs should be properly identified and located on the ground so photos of the area can be re-taken at a later date.

Line intercept transects are often made in conjunction with 3-Step Transects. When a 3-Step Transect is established on a browse type on big-game range, the line intercept data should be collected at the same time.

93.3 — Condition and Trend. The 3-Step Transect, line intercept, and photo will be the principal studies used in determining long-term condition and trend on the range. However, in order to determine the present condition and apparent trend on key areas, other studies will be needed.

Where range analysis has been completed and studies made on key big-game areas, the condition rating and apparent trend of vegetation and soil, as recorded on Site Analysis (form R4 2200-13) (Exhibit 41.3) or Ocular Site Analysis (form R4 2200-8) (Exhibit 42.1) should be used for the big-game range analysis and placed on key areas on the big-game map.

If range analysis has not been made, then site analysis or ocular site analysis will be made and the condition and apparent trend will be determined. These studies will be conducted in accordance with instructions in Chapter 4.

The forage condition rating from the above mentioned studies is a composite of all vegetation encountered. For big-game range, an additional condition rating for browse plants is needed. Therefore, observations will be made on browse species and ratings determined, using the following criteria:

Browse Condition — The browse on big-game range will be rated and the terms excellent (E), good (G), fair (F), poor (P), or very poor (VP) used to describe the various degrees of condition. Refer to Exhibit 93 for browse desirability ratings when making browse condition determinations. The different condition ratings will be characterized as follows:

Excellent Condition (E)

1. Desirable browse plants abundant for the site.
2. All age classes of desirable browse plants well represented.
3. Plants vigorous.
4. Abundant production of forage (twigs).

Good Condition (G)

1. Desirable browse plants moderately abundant to abundant.
2. Intermediate browse plants may be moderately abundant.
3. Least desirable browse plants scarce.
4. Palatable browse plants vigorous, foliage production normal.
5. Crowns of palatable browse plants normal, loose, and open growing.

Some browse plants, such as bitterbrush, show increased vigor with light cropping (up to 40 percent). This should be taken into consideration in this rating.

Fair Condition (F)

1. Intermediate browse plants abundant and conspicuous.

2. Least desirable browse plants may be abundant.

3. Vigor of desirable browse plants fair.

4. Desirable browse plants produce moderate amount of forage (twigs).

5. Intermediate browse plants show moderate amount of hedging.

Poor Condition (P)

1. Desirable browse plants generally scarce and where present, moderately to severely hedged and highlined.

2. Least desirable browse plants may form half or more of the total browse on the area.

3. Vigor of desirable and intermediate browse plants low.

4. Desirable and intermediate browse plants produce small amount of forage, twigs short.

5. Desirable browse plants decadent, up to 50 percent of branches may be dead.

Very Poor Condition (VP)

1. Desirable browse plants may be absent or, if present, inaccessible to animals, or severely hedged and highlined. Often the plants are only stumps or have a club-like appearance.

2. Least desirable browse plants may make up 90 percent of the vegetation.

3. Both desirable and intermediate browse plants, if present, lack vigor, forage production low, twigs short.

4. Many of the least desirable browse plants decadent with more than half the branches dead.

5. Plant density index very low for the site.

Apparent Trend of Browse

1. *Apparent Overall Browse Trend.* The apparent overall browse trend on big-game range will be rated and designated on the bottom of the RAA field sheet and map as to whether the rating is up (↑), stable (→), or down (↓). The overall browse trend will be based on characteristics, as outlined in item 3.

2. *Apparent Trend of Individual Browse Species.* The apparent trend for each desirable browse species encountered during big-game range analysis, is to be determined and recorded by the species symbol on the RA field sheet. The trend will be shown as up (↑), stable (→), or down (↓). Exhibit 93.3-A. The trend of the individual browse species will be based on the same characteristics (Item 3) as for rating the overall browse trend *EXCEPT,* the underlined words are to be excluded, and the data for each vegetative type is to be transferred to the key area record sheet (Exhibit 93.3-B.)

3. *Browse Trend Rating Characteristics.*

Trend up (↑)

a. Desirable and intermediate browse plants — healthy, vigorous, and have good color for the site.

b. Reproduction *of desirable browse species* high, all age classes represented. Percentage of seedlings and young browse plants exceeding the percentage of decadent and dying plants by more than 5 percent.

c. Young browse plants not being pulled up, trampled out, or otherwise destroyed by use of the area.

d. Crown of desirable and intermediate browse species normal, loose, and open growing. Some species such as bitterbrush light cropping (up to 40 percent) increases vigor and should be given consideration in this matter.

e. Two or more years' production of vigorous and healthy regrowth following the heavy hedging *of desirable and intermediate browse plants.*

f. *Desirable or intermediate* browse species displaying few dead branches or plants.

Trend stable (→)

a. *Desirable and intermediate* browse plants with good health but reduced vigor and color for the site.

b. Reproduction of desirable and intermediate browse moderate. Seedling and young age class of *desirable* browse species equal to but not exceeding the percentage of decadent and dying browse plants.

c. *Desirable* browse plants not being trampled out, pulled up, or otherwise destroyed by use of the area.

d. Crowns of *desirable and intermediate* browse plants showing moderate hedging.

e. Evidence of vigorous regrowth following heavy hedging but recurring often and suppressing growth and vigor.

f. *Desirable or intermediate* browse species displaying few dead branches or plants.

Trend down (↓)

a. *Desirable and intermediate* browse plants unhealthy, lack good color and vigor for the site.

b. Reproduction of *desirable and intermediate* browse plants low or nonexistent. Percentage of decadent plants exceeding percentage of seedling and young age plants by more than 5 percent.

c. Young browse plants being pulled up, trampled out, or otherwise destroyed by use of the area.

d. Crowns of *least desirable* browse plants compact, not in normal formation, and showing heavy hedging.

e. No vigorous regrowth following severe hedging. Annual twig production short and few twigs produced.

f. Numerous decadent plants. Live plants with more than 50 percent of the branches dead.

Rating will be shown as in the following example: F, B(↓). This rating would indicate the browse in fair condition with an apparent downward trend.

Records of livestock use, precipitation, and other factors causing changes in range conditions should be recorded for use in interpreting range condition and trend studies.

Photographs, where available, and retaken at intervals are valuable as a means of showing trend.

93.3 A

R-4 RANGE ANALYSIS HANDBOOK

Exhibit 93.3-A

SITE ANALYSIS

WRITE-UP NO.	PHOTO NO.
T-4	CVII-71-15

FOREST	RANGER DISTRICT	ALLOTMENT	EXAMINER	DATE
Bannock	Indian Head	Coyote Creek	Wm. Thompson	7/6/73

TRANSECT NO.	PLOT SIZE	PLOT INTERVAL	TYPE DESIGNATION	KIND OF LIVESTOCK	SLOPE	ASPECT
1 of 1	9.6	1 ch	S5	Sheep	35%	W

LOCATION: In the head of Birch Cr.

ELEV. 9,250

	SPECIES	PLOTS 1	2	3	4	5	6	7	8	9	10	TOTAL PROD.	GRAMS USED	% UTIL.	DRY WT. PROD.	PCT. COMPOSITION	DESIRABILITY RATING
GRASSES	Brca	20		1		5	5	5	5	4	3	43			13	1	D
	Agtr	12	20	2			4	10	10	15	5	78			39	2	D
	Mehu		3	1								4			2	T	D
	Stic					40						40			20	1	C
	Pore			2								2			1	T	D
	Total grass											172			85	4	
FORBS	Pooc	110	110	40	3		45	25	70	4	100	507			152	9	D-I-C
	Hafl	15	25	8		2	141				10	200			60	4	D
	Coli	4		1	5						6	16			5	T	I
	Stja	5	5	3	4	4	6	18		4		49			15	1	I
	Vipu	3	15	4	3	8	15	20	10	4	15	97			29	2	I
	Agpu	3										3			1	T	I
	Thfe	8	5		5		35	15				68			20	1	I
	Acla	4					10					14			4	T	I
	Pedo	2		5	20	2		15		6		51			15	1	I
	Chal		5						3			8			2	T	I
	Dein		3	4	8	2		8	15	6	15	61			18	1	I
	Magl			1	25	20				40		86			24	2	I
	Debr			T								T			T		
	Lual					6						6			2	T	D
	Artr					3						3			1	T	I
	Heho						70					70			21	1	I
	Pofi						6					6			1	T	I
	Vimu	10	35	15	3	8	25	30	30	5	25	191			57	3	I
	Total forbs											1431			420	25	
BROWSE	C&T																
	Artr-P ↓	130										130			45	4	I
	Samz-F →	45	450	40	25		810	720	600	60	480	3230			1130	67	D-I-C / I-C
	Total browse											3360			1195	71	
	Total														1709	100	

												Average
% OVERSTORY (TREES)												
% OVERSTORY (SHRUB)	20	65	20	15		100	90	85	25	60	53	
% CROWN COVER (HERB)												
% BARE GROUND	40	15	70	80	30	20	20	35	70	35	44	
% ROCK & PAV (NAT.)												
% ROCK & PAV (UNNAT.)												
% VEG. & LITTER	60	85	30	20	70	80	80	65	30	65	56	
% SOIL DISTURBANCE												
DROPPINGS												
PELLET GROUPS												

100%

% DESIRABLE 22
% INTERMEDIATE 33
% LEAST DESIRABLE 45

CONDITION RATING:
COMPOSITION RATING 14
PRODUCTION RATING 22
FORAGE CONDITION RATING 36
GROUND COVER INDEX 25
CURRENT EROSION INDEX 33
SOIL CONDITION RATING 53

* 9.6 SQ. FT. PLOT COMES OUT DIRECTLY IN POUNDS PER ACRE WHEN TEN PLOTS ARE TOTALED. ADD A CIPHER (0) TO TOTALS IF 0.96 SQ. FT. PLOT IS USED.

BROWSE: CONDITION Good APPARENT TREND →

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93.3--5

~~93.3-B~~

R-4 RANGE ANALYSIS HANDBOOK

Exhibit 93.3-B

SOIL: SURFACE TEXTURE Silt loam ; THICKNESS 8" ; pH 6.0

SUBSOIL TEXTURE v. st. clay ; THICKNESS 22"+ ; pH 7.0

SUBSTRATUM MATERIAL Calcic sandstone ; EFFECTIVE ROOTING DEPTH 29"

REMARKS Stoniness begins at 24"

EROSION PATTERN: SURFACE LOSSES AVERAGE 2 INCHES OVER 30 % OF THE AREA

GULLIES TOTAL APPROXIMATELY 0 FEET IN LENGTH AND AVERAGE ABOUT — FEET DEEP

REMARKS Evidence of sheet erosion over ½ of the type

INHERENT EROSION HAZARD: DETACHABILITY RATING 7 ; SURFACE COVERED WITH ROCK FRAGMENTS ¼ INCH OR GREATER IN DIAMETER 0 %; ADJUSTED DETACHABILITY RATING 7

PROFILE PERMEABILITY RATING 7 ; SOIL ERODIBILITY INDEX 49 ; CLASS IV

SLOPE 35-40 %; INHERENT EROSION HAZARD, CLASS IV

SOIL DISTURBANCE: COMPACTION None (NONE, LIGHT, MODERATE, HEAVY)

DISPLACEMENT Light (NONE, LIGHT, MODERATE, HEAVY)

COVER DISPERSION: UNIFORM ____ FAIRLY UNIFORM ✓ VARIABLE ____ HIGHLY VARIABLE ____

ESTIMATED POTENTIAL PRODUCTION FOR SITE 1800 LBS. PER ACRE (DRY WT.)

GIVE REASONS FOR SUITABILITY CLASSIFICATION This area is suitable under light to moderate use but would be very susceptible to erosion if the vegetal cover was allowed to deteriorate

ESTIMATED USE BASED ON UTILIZATION

CONVERSION FACTORS: CALCULATIONS

AIR-DRY CONTENT OF GREEN FORAGE

GRASSES & SEDGES	
DUST BEFORE HEADING	25 - 30%
HEADED OUT	35 - 40%
AFTER BLOOM	45 - 50%
SEED MATURITY AND PAST	55 - 80%
FORBS	
VERY LUSH	15 - 20%
FLOWERING	20 - 25%
SEED TIME	30 - 35%
BROWSE	
LUSH LEAVES (SNOWBERRY)	30 - 40%
FIBROUS LEAVES (OAK) & PURSHIA	35 - 45%
RABBITBRUSH & SAGEBRUSH	40 - 60%

ESTIMATED USE BASED ON PELLET OR DROPPINGS COUNT

CALCULATIONS

CONVERSION FACTORS:

13 PELLET GROUPS PER SHEEP DAY

12 DROPPINGS PER COW DAY

PLOT SIZE 1/100 ACRE

A. 3.3 FT. ON EACH SIDE OF TRANSECT LINE

OR

B. SUPERIMPOSED CIRCULAR PLOT WITH AN 11.7 FT. RADIUS

FORMULA FOR A

$$\frac{\text{DROPPINGS PER TRANSECT}}{\text{CHAINS PER TRANSECT}} \times \frac{100}{12} = \text{COW DAYS PER ACRE}$$

FORMULA FOR B

$$\text{AVERAGE DROPPINGS PER PLOT} \times \frac{100}{12} = \text{COW DAYS PER ACRE}$$

DF SU/64

94 — FORAGE PRODUCTION STUDIES. The ability of an area to produce desirable forage for big game will determine its capacity to produce big game. The grazing capacity of the seasonal range units must balance with the time the animals spend on each unit. Therefore, the least productive seasonal unit of range limits the capacity of the entire herd unit.

94.1 — Weight Estimate. The weight estimate method is one used for determining forage production on big-game range key areas. Where grazing analysis sampling has been done on key areas, the data from site analysis (form R4 2200-13) (Exhibit 41.3) and/or the grazing impact analysis (form R4- 2200-8) (Exhibit 53) studies will be used in determining the forage production on the key area.

If the grazing analysis sampling has not been completed on the key areas, and it is determined that a weight estimate study should be made, one or more site analysis studies will be made in accordance with instructions in Chapter 4.

94.2 — Estimated Production. Ocular analysis has been used extensively in estimating forage production and may be used on big-game range key areas if it is determined that this method will furnish the data desired. The ocular analysis study will be made in accordance with instructions in Chapter 4 and the information recorded on form R4 2200-10 (Ocular Site Analysis).

94.3 — Allocation of Available Forage to Big Game and Livestock. Where analysis findings show there is significant common use of range by both big game and livestock, an assignment of available forage to each class should be made.

This can best be done on a percentage basis compatible with present use by each class and in consideration of management policies and future needs.

A determination of deer or elk days' use per acre by means of pellet group counts and converting to cow months is one approach toward arriving at a comparison of use by game and livestock. (See 71.3)

95 — BROWSE UTILIZATION.

95.1 — Twig Measurement.

95.11 — Tagged Branches. Browse utilization transects using twig measurements of tagged branches will be the principal means of accumulating records on browse utilization. This method consists of tagging branches on selected browse plants along a transect and is most effective where the growth tends to be linear.

A recommended procedure to follow in establishing browse utilization transects is as follows:

1. One or more transects should be located to obtain a representative sample of the key area.

2. Establish the transect along a compass course or a line described by metes and bounds tied in to recognizable landmarks or map points. Record this information for the files in such a manner that a new man can easily locate the described points.

3. Tag only branches that are available to the game animal. A common practice is to tag two branches on each of ten different plants along the transect. In addition to tagging the two branches to be measured, tag or flag each plant in an identical place for ease in relocating.

4. Classify each tagged plant according to its form and age class. Where browse such as oak, juniper, and the mahoganies are important on a deer range, the younger age classes are the key to the future forage supply. It is a good idea to segregate or eliminate entirely utilization data on browse plants that are largely unavailable.

This method requires measurement of the twigs in the fall after the growth has stopped and livestock have left, and prior to game moving into the area. Measurements are made in the spring after game have left the area and before new growth has started. For efficiency, a two-man crew is best adapted for making twig measurements which will be recorded on form R4 2600-2, Browse Utilization Field Sheet (Exhibit 95.11-A,B) in the following manner:

95.11-A

R-4 RANGE ANALYSIS HANDBOOK

BROWSE UTILIZATION SUMMARY SHEET

Exhibit 95.11-A

Forest _____
District _____
No. & Name of Game Herd _____
_____

	Period of Use	% Utilization
Deer		
Elk		
Cattle		
Sheep		
Other		

Examiner _____
Location of Transect _____
Aerial Photo No. _____
Plant Species Tagged _____ Exposure & % Slope _____
Specify Year of Growth Measured (current or old growth) _____
Date Examined:
Before Browsing _____ After Browsing _____

Bush & Tag No.	Bush Location (Bearing & distance to marker and location of tag on bush)	Degree of Hedging 1/ and Age Class 2/	Before Browsing			After Browsing	
			No. of Shoots	Length of Shoot: Est. Summer Use	Length of Shoot: Total Length	No. of Shoots	Length of Shoots
Total							

Average Length _____

Notes: _____

1/ For shrubs with large numbers of shoots it will be necessary to develop separate record sheets for listing shoots by length classes. (See reverse.)

2/ Form classes:

All available
1. Little or no hedging
2. Moderately hedged
3. Closely hedged

Largely available
4. Little or no hedging
5. Moderately hedged
6. Closely hedged
7. Mostly unavailable
8. Unavailable

3/ Age classes: S = Seedling, Y = Young plant, D = Decadent plant, M = Mature plan

4/ If grazed before initial measurement, estimate total length of growth and enter in total length column; enter estimated inches utilized in summer use column. Record to nearest inch.

Form R4-2600-2 (5/61)

BROWSE UTILIZATION FIELD NOTES

Exhibit 95.11-B

Plant Species ____________
Bush & Tag No. ________ Date ________

Shoot Length Inches	Before Browsing Number of Shoots	Before Browsing Total Growth Inches	After Browsing Number of Shoots	After Browsing Total Length Inches
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
Totals				
Estimated total inches summer use (if any)				

Plant Species ____________
Bush & Tag No. ________ Date ________

Shoot Length Inches	Before Browsing Number of Shoots	Before Browsing Total Growth Inches	After Browsing Number of Shoots	After Browsing Total Length Inches
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
Totals				
Estimated total inches summer use (if any)				

Plant Species ____________
Bush & Tag No. ________ Date ________

Shoot Length Inches	Before Browsing Number of Shoots	Before Browsing Total Growth Inches	After Browsing Number of Shoots	After Browsing Total Length Inches
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
Totals				
Estimated total inches summer use (if any)				

Plant Species ____________
Bush & Tag No. ________ Date ________

Shoot Length Inches	Before Browsing Number of Shoots	Before Browsing Total Growth Inches	After Browsing Number of Shoots	After Browsing Total Length Inches
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
Totals				
Estimated total inches summer use (if any)				

Notes:

BROWSE UTILIZATION FIELD SHEET

Transect Name & No. _____ Forest _____ District _____ Herd Unit _____

Date _____ Observer _____ Species _____ Date _____ Observer _____

FALL MEASUREMENT														Estimated Summer Use	Number Twigs	SPRING MEASUREMENT													Chips	Pellet Grps.
Tag No.	1	2	3	4	5	6	7	8	9	10	11	12	Total Growth			1	2	3	4	5	6	7	8	9	10	11	12	Total Growth		
									Totals																Totals					

(% Utilization) Game _____ Livestock _____ Ave. Twig Growth _____ (Days Use/Acre) Game _____ Livestock _____

Total _____ (Game and Livestock)

Fall	*Spring*
1. Measure the length of current twig growth of each twig on the branch above the tag to the nearest inch. A twig is defined as all growth above the current annual growth ring. *Current year's growth may branch and is to be recorded as one twig.* Record twig length by placing a dot or line mark in the appropriate column on the field form. Record number of twigs while making measurements as the number of dots for recording growth will not necessarily represent the number of twigs. Accuracy in twig measurement is essential. *The number of twigs per tagged branch should not exceed a maximum of 15 or a minimum of 10.* Tags should be moved on the branch when necessary to maintain this number of twigs.	1. The length of remaining current twig growth on the tagged branch is measured and recorded as in the fall.
2. After all measurements are completed, tally current growth in inches for each branch. Calculate total current growth in inches and number of twigs for entire transect.	2. The remaining current growth in inches is tallied for each branch and totaled for the entire transect.
3. If the plant is used before measurements are taken, estimate the inches of twig growth taken and record this information along with the class of animal involved in the space provided on the field form.	3. Livestock or game summer use as determined by fall measurements is evaluated and recorded separately prior to determining winter use of browse by game (and /or livestock).
4. An examination of current growth of twigs not used in relation to the diameter of the twig where cropped will assist in estimating current summer use by livestock (and/or game).	4. Examination of leaders out of reach or protected from grazing will aid in training to separate current from previous years' growth.
5. One factor that affects percentage utilization from year to year is volume of growth as influenced by variations in precipitation and other climatic conditions. In order to evaluate the influence of volume of growth on degree of cropping, a *growth index*, (total growth measured ÷ total number) of twigs measured is to be calculated. (If summer use has occurred include the estimated total inches removed to determine total growth.)	5. To determine a forage removal factor that can be compared, a *use index* is calculated. (The Use Index = growth index X per cent utilization.) This figure can be compared on a year-to-year basis and is representative of forage consumption.

6. If plant has been used prior to fall measurements, the utilization to date (summer use) is determined by adding the estimated inches of current growth removed to the total inches of current growth measured in the fall, and dividing this total into the estimated inches removed. The answer should be multiplied by 100 to give percent use at date of the fall measurements.

7. On a range receiving occasional extremely heavy use, it is often desirable to measure and record old growth separately above the tag, in addition to current growth, to get a true picture of actual use on the plant.

6. Utilization from time of fall measurements to spring (winter use) is determined by subtracting the total inches of current growth measured in the fall and dividing the remainder by the total year's current growth in inches (fall measurement plus estimated inches removed, if any, at time of fall measurements); multiply the answer by 100 to give percent use during winter.

7. If separate old growth measurements are made, determine use on old growth by subtracting the total inches remaining in the spring from the total inches measured in the fall and divide the remainder by the total fall measurement (assuming no summer use on old growth). The answer should be multiplied by 100 to give percent use of old growth during winter.

The field forms should not be destroyed after the data is tabulated, but should be kept in a closed file for future reference. Branches tagged for browse utilization study should not be used to study browse trend. A separate study to determine trend must be established. Studies have shown that continued use, year after year, of more than 50 to 55 percent of current growth on the more desirable browse will produce an adverse effect on the browse and a deterioration will result.

After all measurements have been made on the tagged branches, the data will be summarized on form R4 2600-2, Browse Utilization Field Sheet (Exhibit 95.11-A,B). After the spring measurements have been made and recorded on the field sheet, the percentage of utilization growth index and use index will be calculated and recorded on the Herd Unit Analysis Summary Sheet (Exhibit 91.21-B&C).

95.12 — Tagged Plants. A modification of twig measurement on tagged branches is to tag individual plants along a transect in a key area.

A predetermined number of twig measurements is made on each tagged plant. Thus 50 or 100 measurements of available twigs are recorded for each plant in the fall and again in the spring. No effort is made to measure the same twigs in the spring as were measured in the fall. However, sufficient twigs have to be measured each time to assure an adequate sample for each twig size class.

Some advantages of this method are:

1. Plants may be easily marked and identified.

2. If sufficient unbiased twig measurements are made on each marked plant to assure an adequate sample, current utilization that is more nearly free from the effects of past use, can be more adequately obtained.

Disadvantages are:

1. There is a possibility of measuring the longer and more conspicuous twigs.

2. No record of the number of twigs is maintained—thus the use is measured but its effect on twig production is not determined.

95.2 — Estimate of Utilization on Important Browse Species. Visual estimate of browse utilization is important on shrubs like sagebrush and ceanothus on which seasonal growth is not easily measured. The following procedure is used to estimate utilization:

1. The bush is examined to reveal the extent of cropping.
2. The bush is mentally reconstructed as to its appearance had it not been utilized.
3. An estimate is made of the amount of seasonal growth that has been utilized.

A comparison of browsed and unbrowsed shrubs should be made in order to arrive at a sound estimate of use. It is a good practice to measure a number of uncropped leaders to help the eye in estimating twig lengths. Where heavy use prevails, it may be necessary to protect some shrubs by cages in order to have uncropped plants available for comparison. The bush is then scanned to determine if the measurements are representative of the seasonal growth on the entire bush. The average length of the cropped leaders is then determined and an estimate of the percentage of the twigs that have been cropped is made and utilization percentage figured. Example: If the average length of uncropped leaders is 5 inches, the average length of cropped leaders is 3 inches and 40 percent of the leaders have been cropped, then the average utilization would be 40 percent use on 40 percent of the leaders or 16 percent average utilization.

Classification of the current use on browse plants into the following categories may be sufficient on key areas of some units where there are no browse forage problems.

No use — No evidence of use of current growth.

Light use — 0 to 25% use of current growth used. Cropping of current growth not readily apparent from a distance, but shows up on closer examination or less than half of the current growth is moderately cropped and balance is not cropped.

Moderate use — 25 to 55% use of current growth. Cropping of current growth is apparent, but the shrub does not appear to be lightly cropped; less than half of the current growth is heavily cropped and the balance is lightly cropped.

Heavy use—55% or more use on current growth. From a distance, shrub appears to be cropped with most of the current growth showing heavy utilization upon closer examination.

Very heavy use — Overuse of current growth. From a distance, shrub appears to be heavily used.

95.3 — Intensity of Use.

95.31 — Pellet Group Counts. Pellet groups counts are used to determine:

1. The number of days' use per acre by game on a given area.
2. The relative big-game population density between two, three, or more areas.
3. The total number of big-game animals that used a given range unit when the number of days the game have been on a unit and the acreage within the unit are known.

Pellet group and dropping counts may also be used to give reliable data as to competitive use between big game and cattle on a key area. If big game and cattle use the area at the same time, pellet group and dropping counts are made at the end of the period of use. If the area is used by big game and cattle at different seasons of the year, best results would be obtained by making pellet group counts after the game have left the area and then make the dropping counts at the close of the grazing season for cattle.

Studies have shown that mule deer pass an average of 13 groups of droppings per day and that there will be an average of 12 droppings per day for cattle.

Pellet group counts are usually made on plots of 100 sq. ft. or 1/100 acre in size. On areas where there has been extensive use, a more accurate pellet group count can be made on the smaller plot of 100 sq. ft. Use of the 1/100-acre size plot is adequate on transects where grazing use is light to moderate and where all pellet groups on the plot can be readily seen and accurately counted.

The main value of pellet group counts is to determine the intensity current use and the trend of use over a period of years on a given unit of game range.

Counts are made in conjunction with other studies such as site analysis, grazing impact analysis, ocular analysis, 3-Step Transects, and line intercept transects. They can also be made independently from these studies in order to obtain more data on grazing use.

Either strip plot or circular plots can be used in making pellet group counts.

Strip plots are suitable if a definite centerline exists, for example: along the legs of a 3-Step Transect cluster and along the tape of the line intercept transect. The dimensions of the strip plots are: 3.3 ft. either side of a line 66 ft. long=1/100 (.01) acre; 3.3 ft. either side of a line 99ft. long=15/1000 (.015) acre.

Circular plots at predetermined intervals can be used efficiently when sampling of a key area is by pacing in conjunction with a forage utilization transect, a site analysis or ocular analysis transect. This method can also be made independently of the other studies where only the intensity of use of an area by big-game animals is desired. The dimension of a circular plot of 100 sq. ft. is 5 ft. 7 in. radius and of a 1/100 acre is 11.75 ft. radius. Records can be made on form R4 2600-1 (Exhibit 95.31).

The following procedure is used in making pellet group counts:

Strip Plot Method

1. Count and record the number of pellet groups by traveling on one side of the tape to the desired plot length (66 ft. for .01 acre or 99 ft. for .015 acre) and returning on the opposite side of the tape to the starting point.

2. Use a carpenter's or similar rule to delineate the exterior boundary of the plot and to check borderline groups.

R-4 RANGE ANALYSIS HANDBOOK

PELLET-GROUP COUNT RECORD

Exhibit 95.31

.....
(Transect Name and Number)

.....
(Forest) (Ranger District)

.....
(Area)

.....
(Game Herd)

.....
(Date)

Location of transect and plots.....

.....

.....

Veg. type ..... Slope .....Examiners .....

Size of plots[1] — 1/1000 a. ( ) 1/100 a. ( ) 100 sq. ft. ( ) other ( ) Pellet-group counts by plots:[2] (Specify animal involved)

	Species															
	Deer	Elk			Deer	Elk			Deer			Deer	Elk			Deer	
1				11				21			31				41		
2				12				22			32				42		
3				13				23			33				43		
4				14				24			34				44		
5				15				25			35				45		
6				16				26			36				46		
7				17				27			37				47		
8				18				28			38				48		
9				19				29			39				49		
10				20				30			40				50		
TOTAL																	
AVE:																	

Summary

	Deer	Elk	Other (Specify)
1. Total pellet groups counted (all plots)			
2. Average number of pellet groups per plot			
3. Total acres[3] counted (no plots x size of plot)			
4. Pellet groups per acre $\frac{\text{(total pellet groups)}}{\text{(total acres counted)}}$			
5. Days per acre[2] $\frac{\text{(pellet groups per acre)}}{\text{(13 (game) or 12 (cattle))}}$			
6. Number acres in area sampled			
7. Total days' use on area (#5 x #6)			
8. Average number of days' use on area			
9. Total number animals on area $\frac{\text{(\#7)}}{\text{(\#8)}}$			

1. 1/100-acre transect — 6.6 feet (79.2 inches) x 66 feet; or 6 feet (72 inches) x 72.6 feet. 1/100-acre circle, 11-foot 9-inch radius; 1/1000-acre circle; 3-foot 8-inch; 100-square-foot circle, 5-foot 7-inch radius.
2. Tally groups separately by species, that is, deer, elk, cattle, and specify which species is involved in summary.
3. Correction factor for 100-square-foot plot is $\frac{100 \times \text{number of plots}}{43{,}560}$

R4-2600-1 (5/64)

Circular Plot Method

1. Locate the center of the circular plots at predetermined intervals along the transect or compass line as the key game range is traversed.

2. Mark the center of each plot with a stake to which a wire or light rope has been attached so that it will pivot freely. Circumscribe the perimeter of pellet groups within the plot. Checking the number by making a second trip around the plot in opposite direction will give a higher degree of accuracy.

The following items must be considered for either method used:

Care must be taken to count only those groups deposited during the previous period of range use to be measured, i.e., winter, summer, or full year.

Preferably 20 or more plots should be counted in sampling a key game range area in conjunction with each browse utilization or independent pellet group count transect. An exception to this is the small number of strip plots that are counted at 3-Step Transect or line intercept transect locations.

The pellet groups for each big-game species should be recorded separately. From this compute the total number of groups per acre for each species using one of the following formulae:

$$\frac{\text{For 100 sq. ft. plots}}{\text{Total number pellet groups}} \div \frac{100 \times \text{number of plots}}{43{,}560} = \text{Number pellet groups per acre}$$

$$\frac{\text{For 1/100 acre plots}}{\text{Total number pellet groups}} \div \frac{\text{Number of plots}}{100} = \text{Number of pellet groups per acre}$$

Determine the days' use per acre by dividing the number of pellet groups per acre by 13.

95.32 — Fenced Study Plots. Dual enclosures can be constructed on key areas used by both big game and livestock and studies made to determine grazing use intensity by each class of animals. This study should consist of three plots of at least one acre each. One fenced plot should exclude all grazing use, an adjacent plot would permit big-game use but exclude livestock, and the third or control plot would be unfenced to permit grazing by both big game and livestock.

Studies on the dual type enclosures are particularly desirable where there is a need to determine the amount of use by both big game and livestock. Pellet group and dropping counts should be taken annually. It may also be desirable to make browse utilization studies at these enclosures if it is apparent that livestock use important browse species.

95.33 — Use of Utilization Cages. Utilization cages are valuable tools for use in wildlife habitat studies. On key areas where there is excessive use of browse plants, it will be desirable to use cages to protect some plants in order that normal twig growth can be compared with utilized twigs. Protected plants are valuable as a guide to forage variations due to yearly climatic changes. The cages may be used as demonstration plots to show utilization rates. It is often desirable to have some permanent utilization cages on a key area in order to have a basis for determining vigor of browse plants, especially where there are no fenced exclosures, or relic areas to be used for comparison.

95.4 — Other Studies.

95.41 — Habitat Studies. On some Forests, there have been established, on key areas, quadrats, browse plots, clipping studies, photo plot transects, or other studies. Studies such as these should be continued if data from them will be of value.

95.42 — Trend Counts. In the past, emphasis has been placed on game counts. Studies have indicated it is not practical, and almost impossible, to accurately count numbers of deer on a typical deer range. In some states, personnel from the Forest Service, State Fish and Game Departments, and other land management agencies cooperate in making trend counts of big-game animals.

Counts repeated for several years provide an indication of herd trends. This information should be correlated with habitat studies such as forage production and utilization. These records should be maintained currently by herd units. (Exhibit 92.21-B).

95.43 — Hunting Records. Kill records, sex-ratio counts, and similar studies have been used to furnish valuable information on big-game herds using National Forest range. These records and studies should be maintained currently by herd units. (Exhibit 92.21-E).

96— RECORDING AND ANALYZING HERD UNIT DATA. All information and data pertinent to each species of big game will be placed in a separate classifile folder and filed under the following designation:

Example: 2620 Planning
(Surveys, Studies, Plans)
Big-Game Range Analysis
South Fork Deer Herd

Herd unit classifile folders should be organized as follows:

Page #1 Written and Graphic Section

1. Unit management plan
2. Herd unit maps
3. Aerial photograph when used

Page #2 Correspondence

Page #3 Herd Unit Analysis Summary Forms

1. Land area and approximate ownership
2. Key area record
3. Herd unit trend count summary
4. Browse utilization transect trend
5. Growth index trend
6. Use index trend
7. Pellet group transect summary
8. Forage removal per acre trend
9. Herd unit kill summary

Page #4 Utilization and Pellet Group Field Sheets

Page #5 Condition and Trend Studies

1. Parker 3-Step (reference list of transect name, number, and where they are found in the range 3-Step file.)
2. Line intercepts
3. Pho plot studies
4. Exc ures
5. Range analysis field sheets

Page #6 Special Studies

Each District Ranger will maintain a separate folder for each species of big game for each herd un on his District. Any data gathered previous to designatin the herd unit and starting e big-game range analysis should e filed in the above designated folder and cross-re renced in the original folder. Information gathered and studies made in range analysis will be used where applicable in the big-game range analysis. Cross-reference notes for data pertinent to big-game habitat management should be filed in the 2620 folder so the information can be readily located for use.

Factual records including photographs should be kept current and maintained by herd units over a period of years in order to show actual trends. Past records should be incorporated on these up-to-date forms.

97—REFERENCES

(1) Rasmussen, D. I. and Doman, E. R.
Census Methods and Their Application in The Management of Mule Deer.

(2) Dasman, William P.
1951. Some Deer Range Survey Methods, California Fish and Game. Vol. 37, No. 1.

(3) Parker, Kenneth W.
1951. A Method for Measuring Trend in Range Condition on National Forest Ranges.

1953. Instructions for Measurements and Observations of Vigor, Composition, and Browse. U.S.F.S. Washington Office.

(4) Lewis, Mont E.
1951. G-Management Capacities (Range Reanalysis).

WILDLIFE AND FORAGE REMOVAL

Estimated Forage Taken (in pounds air dry weight) Correlated with Pellet Groups

Pellet groups or droppings per 1/100 acre	Days use per acre based on 13 pellet groups per day[1]	Estimated Forage Removal Per Acre		
		ANTELOPE 3# per day by antelope 90# animal[2]	MULE DEER 4.5# per day by deer 135# animal[2]	ELK 11# per day by elk 425# animal[2]
0.10	0.77	2.3	3.5	8.5
0.13	1.0	3.0	4.5	11.0
0.25	1.9	5.8	8.7	21.2
0.33	2.5	7.6	11.4	27.9
0.50	3.8	11.5	17.3	42.3
0.75	5.8	17.3	26.0	63.5
1.0	7.692	23.077	34.615	84.615
2	15.4	46.2	69.2	169
3	23.1	69.2	104	254
3.9	30	90.0	135	330
4	30.8	92.3	138	338
5	38.5	115	173	423
6	46.2	138	208	508
7	53.8	162	242	592
7.8	60	180	270	660
8	61.5	185	277	677
9	69.2	208	312	762
10	76.9	231	346	846
1.2	9	.....	.....	100
2.9	22	.....	100	.....
4.3	33	100	.....	.....

1. 13 pellet groups per day per animal is based on experimental data for deer. Assumed to be the same for antelope and elk.

   Formula:

   $$\frac{\text{No. Per Acre} = \text{Deer days use}}{13} \qquad \frac{\text{No. Per Acre} = \text{Deer months use}}{390}$$

2. Based on review of numerous feeding studies and determination of average herd run weights.

DOMESTIC LIVESTOCK AND FORAGE REMOVAL

Etimated Forage Taken (pounds air dry weight) Correlated with Pellet Groups and Droppings

Pellet groups or droppings per 1/100 acre	Days use per acre based on 13 pellet groups per day[1]	Estimated Forage Removal Per Acre		Days use per acre based on 12 dropping groups per day[4]	Estimated Forage Removal Per Acre By cattle 20# per day 800# animal
		2.75# per day by 1/2 permitted sheep[2] 90# animal	4# per day by average ewe[3] 125# animal		
0.12	.....	.....	.....	1.0	20.0
0.13	1.0	2.75	4.0	.....	.....
0.25	1.9	5.3	7.7	2.1	41.7
0.33	2.5	7.0	10.2	2.8	55.0
0.50	3.8	10.6	15.4	4.2	83.3
0.75	5.8	15.9	23.1	6.3	125
1.0	7.692	21.154	30.769	8.333	166.667
2.0	15.4	42.3	61.5	16.7	333
3	23.1	63.5	92.3	25.0	500
3.6	.....	.....	.....	30	600
3.9	30	82	120	.....	.....
4	30.8	84.6	123	33.3	667
5	38.5	106	154	41.7	833
6	46.2	127	185	50.0	1000
7	53.8	148	215	58.3	1167
7.2	.....	.....	.....	60	1200
7.8	60	165	240	.....	.....
8	61.5	169	246	66.7	1333
9	69.2	190	277	75.0	1500
10	76.9	212	308	83.3	1667
.6	.....	.....	.....	5	100
3.25	25	.....	100	.....	.....
4.7	36	100	.....	.....	.....

1. 13 pellet groups per day per sheep are based on experimental data for deer. Formula:

   $\frac{\text{No. per A.}}{13} = \text{Sheep days use}$ $\frac{\text{No. Per A.}}{390} = \text{Sheep months use}$

2. A permitted sheep, in usual R-4 summer grazing practices, includes two animals, a 125# ewe, plus a lamb with average summer weight of near 55#, or a total of 180# of sheep. The 180# of animal will take an estimated average of 5.5 pounds of air dry forage per day. Pellet group counts indicate the number of individual animals, and would therefore show two times the permitted number in the case of ewes with a 100% lamb crop. Forage removal of 2.75# per day per animal would therefore be ½ of the removal per permitted sheep.

   Examples: One pellet group per 1/100 acre=7.69 sheep days use, or 21.15# of forage removal per acre (based on ewe-lamb average).
   Two pellet groups per 1/100 acre=15.4 sheep days use or 42.3# of forage removal per acre, but only 7.69 *permitteed sheep days use per acre.*

3. Domestic ewe weight is the estimated R-4 average.

4. 12 droppings per day per animal for cattle are based on experimental data.

   Formula: $\frac{\text{No. Per Acre}}{12} = \text{Cattle days use}$ $\frac{\text{No.}}{\text{Acre}} = \text{Cattle months use}$

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PRACTICAL BIG GAME RANGE SURVEY METHODS*

We could spend days or weeks discussing range survey principles and methods. There are many different systems and procedures, some most popular in the East, others in the West. We cannot begin to describe them all. So we will take up a few basic approaches and make mention of some of the variations.

It has been said that a migratory deer herd unit is made up of a winter range (or group of related winter ranges or deer yards) and the complementary spring, summer and fall range where the majority of the animals that use the winter range spend the balance of the year. Usually the winter forage on winter range is not only limited in quantity but almost always in quality. And, because of these limitations, the winter range often places a ceiling on the number of deer a herd unit can support. We will assume that all of these conditions apply to our deer herd unit.

Our first job is to locate and delineate the winter range. The increasing human population will be of help to us here. There are enough people about nowadays that someone will know where deer are seen in the winter. Once we get the general area located, the snowline, the differences in vegetative cover, the variation in elevation and exposure, and the deer sign, will enable us to draw a boundary around the range used by deer during the winter period.

At this stage of our investigation, we will want to make use of the key area concept.

Key Areas

The pattern of use by grazing and browsing animals is seldom even. On some ranges, it is so uneven that it results in areas of light, moderate, and heavy cropping of forage. This is true particularly on winter ranges where snow concentrates deer during the mid-winter period. As a result, the forage plants on these concentration (or key) areas are subject to much heavier use than occurs elsewhere on the range. It follows, therefore, that when the preferred forage on key areas is not over-browsed, over-browsing should not occur elsewhere on the winter range (2).

Key areas can serve the deer range manager once they are

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* Prepared by William P. Dasmann, Division of Range & Wildlife, Region 5, Forest Service. 9/11/62.

located. He can give these critical areas the attention they deserve. For, if he takes care of the key areas on a range, the rest of the range should take care of itself.

So the next step is to locate the key area or areas by a reconnaissance survey. This is not so hard as one may think, but it will involve considerable foot or horseback travel. We can find the key areas by the range sign. The areas where forage is most heavily used and where deer droppings are most numerous, are usually the portions of the range upon which survival of the deer herd is dependent.

If the key area is subject to heavy use, and many of them are where deer populations are not closely regulated, there will be various indicators that will be evident to the trained eye. Some of these indicators of deer range abuse are:

Absence of seedlings and young plants of preferred forage species,
Poor vigor of better browse species,
High browse lines on tall shrubs,
Dead, dying and severely hedged shrubs,
Moderate to heavy use of "starvation" forages,
Preferred browse species present only on protected sites,
Excessive deer trails,
Abundant droppings,
Excessive use on ridges,
Heavy trampling around salt licks (7).

Through the use of range sign, together with information about mid-winter snow-depths, as well as exposure and cover types, we will be able to draw a boundary around key areas. These are the portions of the range where we will make an intensive survey, because these are the areas that must be maintained, improved, or extended, if we are to stay in the deer business.

We said we will make an intensive survey. Of what does such a survey consist?

First of all, it will consist of a range inventory. We will want to find answers to the following questions:

What do we have?
What condition is it in?
Is the condition getting better or worse?

In short, we will want to make a range condition and trend survey. Most range managers are convinced that this type of survey is basic to intelligent management of ranges.

Let's assume we have found that the winter range covers about 100,000 acres, a good round number, and that the key areas cover at least 30,000 acres. Obviously, we won't be able to examine each acre or classify each shrub. We will need to resort to range sampling in order to get the information we need.

Range Sampling

In this age of public opinion polls, nearly everyone has some understanding of sampling. So we will proceed immediately to say that range sampling can be very complex or quite simple. Range scientists involved in research will need to use the more complex methods. These involve stratification of sample areas, randomization of sample plot locations, statistical analysis of sample data in order to determine confidence limits and the like. Some range managers have yielded to the temptation to use the research approach, and have become bogged down in detail. But we will settle for simpler methods.

If our only interest was to determine the present condition of the key areas, we could just ride or walk throughout the range and form a judgment on basis of range sign. Any trained range examiner, through reconnaissance survey, can tell whether a range is being used lightly, moderately, heavily or excessively. But we want to establish bench-marks that can be used at a later date to determine whether the condition of the range is getting better or worse. So, we will need to do more than reconnaissance.

Memory is a poor substitute for recorded measurements. And even if the broad-scale estimates of reconnaissance surveys are recorded, they cannot escape the influence of individual bias. Today we may decide that 50 percent of the key forage plants are over-browsed. Tomorrow, in a different light, we may agree that only 35 percent belongs in this category. Obviously, this is not good enough. For the changes in condition of range vegetation often are so gradual and so unapparent that broad-scale evaluations are not adequate for the detection of range trend. To pin the thing down, we will have to make actual counts and measurements. We will need to establish permanently located sample plots on representative portions of key areas.

What do we mean by representative sites? . . . not the most lightly used parts of the range, surely, nor the most heavily used parts. Rather, we will pick out areas that are more or less typical of the general condition found on the key area. We said "more or less typical"; it doesn't matter really if we lean a little one way or the other. But it is essential that we pick areas that support key forage species.

Key Forage Species

We know that deer exhibit preference for certain kinds of

forage. It follows that such preferred species, like key areas, can be used to reduce the problem of sampling. Because key forage species are subjected to the heaviest browsing, it can be assumed that no other forage species will be over-browsed so long as the most preferred forages are properly used (2). As said before, it is important that key species be determined on each range because forage preferences of deer change with site, season, and composition of cover. Once they are determined, however, the range examiner can limit his observations to a limited number of the more important forage species. This simplifies the job immensely.

It should be remembered, though, that on most ranges there are plant species of very limited abundance which are sought by deer and heavily cropped wherever found. Not offering sufficient volumes of forage to serve as a practical base for management, such plant species should not be called key species, but rather "ice cream" species.

We could wait to determine the key species on the winter range by a special survey. But in the course of our reconnaissance we observed that bitterbrush and curlleaf mahogany were by far the most heavily browsed forage species on the range. So we will be careful to choose sample areas where one or the other of these key forage species are present in typical numbers. We are now ready to establish the first sample plot.

Suppose we plant two marker stakes in the ground some distance apart, and stretch a tape in a straight line between the two stakes. If we make a careful record of the kind and condition of the plants that occur directly under or over the tape, we will end with an inventory of the vegetation on a definite area on a definite date. Now, if we come back, or some other examiner comes back, five years hence and stretches a tape between the same marker stakes and makes a similar record of the vegetative cover, the two records can be compared to determine what changes have occurred in the interval. And, if it is obvious that significant changes have occurred, nobody can gainsay the fact that at the very least a change has occurred in the vegetation along the line of survey.

Now, let us extend this thesis to take in more ground, establishing a dozen or more transects on representative sites scattered throughout the key area. If our re-survey shows that changes have occurred on all or most of the sample plots, who can doubt the probabilities are high that similar changes have occurred throughout the key area?

If you accept this, we are ready to proceed. If you don't you had better return to research methods. But let us assume you are content and ready to get on with the job.

Now, we will have to choose which kind of sample plot to use.

We have talked about stretching a tape between two permanently located stakes or markers. Actually, several survey methods are based on this approach. But we will describe only one . . . the line-point transect. Other methods are based on areas of ground, rather than lines. We will describe two of these area methods, the belt transect and the circle-plot transect. All of the methods described are simple in principle and fairly rapid in application. Personal judgment is to a large extent limited to yes-or-no type of decisions. Men can learn rather quickly to gather data with these survey methods that will be adequately uniform.

Line-Point Method

The line-point method is best adapted to open, rather than dense, vegetation types. With this method, a hundred foot tape is stretched between two permanently located iron stakes (usually 1½-2 inch angle iron). The dominant class of cover that occurs directly under or over each of the foot-marks on the tape is recorded on a field form. Because there are 100 marks on the tape, the number of hits on each class of cover can be used directly as percentages (3).

If the vegetation is scattered or patchy, we may want to extend the length of transect to 200 or 300 feet and make readings at every second or third foot in order to sample all elements. Or we can read each of the 200 or 300 points and divide the sum by two or three to get percentages (3). Or else a cluster of two or three separate 100 foot transects can be established at each of the sample sites (13).

In the line-point method, it is the frequency of cover that is measured, rather than the ground area covered by vegetation or the actual number of plants in the stand. But the method does provide a simple and precise way to measure cover as it exists on a specific line on the date of survey.

Two slightly different line-point methods are in use. The most common is the Parker 3-Step Method developed by the Forest Service (10). This method was designed primarily to measure herbaceous cover. The tape usually is placed within a few inches of the ground surface, and a rod with a steel loop (3/4 inches in diameter) is held in a vertical position at each of the foot-marks on the tape. The class of cover which occurs within the loop is recorded. All measurements are made on the left side of the tape as the examiner proceeds from the zero to the 100 feet end.

Hits on live crowns of shrubs are recorded by species. Hits on dead shrubs that are still rooted in place and on dead portions of living shrubs are also recorded by species, and the class of cover on the ground directly underneath is recorded. The occurrence of annual vegetation within the loop ordinarily is recorded by dot tally.

R-5 RANGE CONDITION & TREND

Fimure 1

RECORD OF PERMANENT LINE TRANSECT

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_____ NATIONAL FOREST

Allotment	Cluster No.	Transect No.	NAMES OF OBSERVERS
Date	Reference Marker and Location — WHAT AND WHERE – DESCRIBE		
Witness Point. — TREE, ROCK, IRON POST – DESCRIBE	Bearing and Dist, from Ref. Mark		
Bearing and Dist. to Stake:		Transect Bearing from 0.0 End	
Length of Transect	Range Type		

LOOP HIT RECORD

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
)	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

PLANT SPECIES TALLY 1)

Hits on Herbaceous Species:

Primary spp. _____

Secondary spp. _____

Sub Total P & S Species _____

Adjusted Limit P & S Spp. 2) _____

Low Value spp. _____

TOTAL HERBACEOUS HITS

Hits on Shrub Species: 3)

Preferred _____

Staple _____

Low Value: _____

TOTAL SHRUB HITS

SUMMARY – TRANSECT LOOP RECORD

	SYMBOL	HITS
Bare soil (less than 1/8" dia.)	P	
Erosion pavement (1/8" – 3" dia.)	R	
Rock (over 3" dia.)	L	
Litter	M	
Moss and Lichens	D	
al plant hits		
TOTAL TRANSECT HITS		100

AVE. MAX. CURRENT GROWTH

Spp.	Leader	Leat	Secondary

GENERAL VIGOR

85%+ High | 50-84% Average | 49%- Low

(circle one)

1) List all important species, whether or not 'hit' in loop. (5 a)

2) See page 18, R-5 Field Guide.

3) See Deer Browse Preferance ratings, R-5 Field Guide.

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If more than one species occurs within the loop, all species are recorded.

The other line-point method was developed by the California Department of Fish and Game primarily for measuring shrub cover (3). With this method, the tape usually is located several feet above the ground. It is similar to the Parker 3-Step Method except for the following differences.

A four inch (rather than 3/4 inch) circle is used for measuring vegetation, reportedly because it is large enough to overcome the influence of non-significant elements and yet small enough to allow rapid decisions.

The centers of the four inch circles are located by hanging a plumb-bob from the tape footmarks.

The class of cover which dominates the area within the circle is recorded, except that (a) hits on browse are recorded when the point of the plumb-bob falls within the living crown of a shrub, and (b) hits on perennial grasses are limited to those where the root-crown is hit by the plumb-bob point (3).

Also, with the California method, a hit is recorded for shrubs or bushy trees when the plumb-bob falls within the perimeter of the living crown even though the point is directly over or under an interspace. It is claimed that, were such interspaces recorded as misses, the growth or loss of a few leaves or small twigs might result in data indicating changes not warranted by actual conditions. The same standard, but more strictly applied, is used for dead shrubs which are still rooted in place (3).

With both methods, bare soil is defined as all soil and rock particles under 1/8th inch in diameter. Rock particles from 1/8th to 3/4 inches in diameter are classed as erosion pavement. Rocks over 3/4 inches in diameter are recorded as rock. Litter is defined as all dead organic matter on the ground surface, except shrubs that are still rooted in place.

With both methods, individual shrubs and other plants are identified for future reference by recording each hit in a box labeled with the tape foot-mark at which it occurred. A sample form, showing the method of recording the data, will be found in Figure 1. Once a line-point transect is surveyed and the data recorded, the positions of all plants are fixed. This position record helps in re-locating the tape during subsequent surveys and may help trend interpretations in the future.

So much for line-point transects. Now, let us consider the survey methods that are based on ground surface areas, rather than lines.

Belt Transect Method

Belt transects may be of any width or length, but to be classed as a belt they should be considerably longer, than wide. The type of belt described here was developed by the Forest Service (Region 5) as a method to determine:

> the kinds and numbers of forage plants,
> the annual supply of browse,
> the degree of deer demand,
> the effect of deer use on the browse resource (13).

The belt transect has an advantage over the line-point transect in that it can provide actual number composition of browse stands, rather than index data. It is used in open vegetation types where foot travel along a straight line may be done with minimal hindrance, and where deer droppings can be counted while pacing the strip.

A belt five feet wide and 660 feet long is used. The area involved is approximately 1/13th acre. The transects are marked at both ends with painted angle-iron posts. Liberal use of paint on rocks and trees along the centerline is recommended as an aid in relocation.

During the initial survey all shrubs that are rooted within the belt are tallied by species and classified. During subsequent surveys, observations may be confined to preferred, or to preferred and staple, forages since these are the plants that will be the first to show response to either heavier or lighter use.

You may wonder why a 1/13th acre size transect was chosen when there are so many round numbers available. We will see why a little later, when we discuss deer pellet-group counts.

Circle Plot Transect Method

Where the vegetative cover is so dense that foot travel along a straight line is difficult, the Forest Service in California uses a circle-plot transect. This consists of a five or ten chain line along which ten circular plots of 70½ inch radius (1/400th acre) are spaced at either half or full chain intervals. The ten circular plots add up to 1/40th acre (13).

The ends of the transect are marked with angle-iron posts. The centers of each of the circle plots are marked with iron reinforcing rod. All shrubs rooted within the plot are tallied by species and classified for condition.

Where straight lines do not fit the vegetation types or terrain, a V, U or L shaped line may be used for either belt or circle-plot transect.

Figure 2

BROWSE TRANSECT RECORD

(Form and Age Class Data)

FOREST: ______ INSPECTION UNIT: ______

RANGER DISTRICT: ______ TRANSECT NO: ______

MGMT UNIT: ______ KIND OF TRANSECT 1/40 ac ( ) 1/13 ac ( )

KEY AREA: Date: Examiner:

LOCATION OF TRANSECT:

BROWSE SPECIES	FORM AND AGE CLASS[1] 1	2	3	4	5	6	7	8	AGE CL. TOTAL
	S M / Y D	S M / Y D	S M / Y D	S M / Y D	S M / Y D	S M / Y D	S M / Y D	S M / Y D	S M / Y D
FORM CL. TOTAL									
	S M / Y D	S M / Y D	S M / Y D	S M / Y D	S M / Y D	S M / Y D	S M / Y D	S M / Y D	S M / Y D
FORM CL. TOTAL									
	S M / Y D	S M / Y D	S M / Y D	S M / Y D	S M / Y D	S M / Y D	S M / Y D	S M / Y D	S M / Y D
FORM CL. TOTAL									
	S M / Y D	S M / Y D	S M / Y D	S M / Y D	S M / Y D	S M / Y D	S M / Y D	S M / Y D	S M / Y D
FORM CL. TOTAL									
	S M / Y D	S M / Y D	S M / Y D	S M / Y D	S M / Y D	S M / Y D	S M / Y D	S M / Y D	S / Y
FORM CL. TOTAL									
	S M / Y D	S M / Y D	S M / Y D	S M / Y D	S M / Y D	S M / Y D	S M / Y D	S M / Y D	S / Y
FORM CL. TOTAL									
	S M / Y D	S M / Y D	S M / Y D	S M / Y D	S M / Y D	S M / Y D	S M / Y D	S M / Y D	S / Y
FORM CL. TOTAL									
	S M / Y D	S M / Y D	S M / Y D	S M / Y D	S M / Y D	S M / Y D	S M / Y D	S M / Y D	S / Y
FORM CL. TOTAL									

1) SEE BACK OF PAGE FOR DEFINITIONS OF FORM AND AGE CLASSES. (4a)

So much for the three kinds of sample plots. Let's choose one or the other of them and plant our end-stakes on the ground. Let's hammer those stakes in real deep! It is surprising how many range examiners are content to implant "permanent" stakes only six or eight inches into the ground if the going is hard. But these stakes are supposed to stay in place for 50 or 100 years or more if we are to get the true value out of condition and trend plots. Perhaps we should consider adding a bag or two of "readi-mix" concrete to our survey kit, and make a practice of pouring a concrete collar around each end-stake. Future generations of deer range managers may bless us if we do.

We have our transect located and are ready, at last, to start the measurements. But there are other elements to consider. We want to make a record not only of the kinds and present condition of the browse. To do this, we must know about age classes and form classes.

Browse Age Classes

It usually is sufficient to classify browse plants into seedlings, young plants, crown-sprouts, mature plants, decadent plants and dead plants (3). We will describe briefly each of these classes.

Seedlings are very young plants which have survived the early die-off period. Each favorable year, thousands of seeds germinate and produce small seedlings, the majority of which succumb to one cause or another before the year is out. It is the fraction of these which survive and become established that are of interest, the one, two, three year olds. Such very young plants can be distinguished by their relative size, simple branching, and succulent bark. With tree species, both seedlings and saplings will fall into this category.

Young plants are larger, and have more complex branching and more fibrous bark, than do those in the seedling class. But they do not show the size and other signs of maturity, such as the rounding off of crown and heavy fibrous stems. With trees, the pole class falls into this category.

Crown-sprouts develop from the root-crown of some browse species after burning or crushing. They are so classed until they begin to show the characteristics of mature plants.

Mature plants will be distinguished by their complex branching, rounded growth form, larger size, and heavier and sometimes gnarled stems. The crown should be made up of more than three-quarters living wood.

Decadent plants are defined as those shrubs or trees which

are dying from age or other factors. Their crowns should show one-quarter or more dead wood.

Dead plants include only those dead shrubs and trees which are still rooted in place on the range.

Browse Form Classes

Form classes of woody plants, as used in deer range surveys, are a composite rating of both degree of hedging and of present availability of forage.

When shrubs or trees are not browsed, or only lightly browsed, they tend to assume the natural forms, or shapes, which are normal for each species. As intensity of browsing increases, the departure from these normal shapes becomes more striking. Continued heavy browsing, year after year, results in tightly hedged or highlined, and partly dead browse plants, which stand out as evidence of poor condition and declining forage yield (3).

Degree of hedging is broken down into three classes as follows: little or no hedging, moderately hedged, and heavily hedged. Hedging is a product of past use and should not be confused with current cropping. The tightly hedged class is reserved for shrubs so closely cropped they are being damaged, are losing vigor, and are moving into decadence.

Browse plants are classed for availability as: all available, largely available, mostly unavailable, and unavailable. It is believed that this classification will cover most conditions found in the field.

The composite ratings (or form classes) of browse plants are broken down as shown below:

Form class 1: All available, little or no hedging
2: All available, moderately hedged
3: All available, heavily hedged
4: Largely available, little or no hedging
5: Largely available, moderately hedged
6: Largely available, heavily hedged
7: Mostly unavailable
8: Unavailable

Availability may result from height, location, or density of plants. For most races of deer, the browsing height limit has been set at five feet.

Individual browse plants are considered as all available if they are under five feet in height, even though some of the interior growth may not be available for browsing. Where shrubs or trees occur

in dense stands, leaving only the growth around the margins of the stand available for deer, such stands or patches should be classified as largely available or mostly unavailable depending on condition even though less than five feet tall.

Browse plants that are growing out of reach of deer, but which still offer considerable forage below the five foot level, are classed as largely available. Where browsing, shading or other factors, have killed most of the available growth below the five foot level, or along the margins of impenetrable brush stands, the browse should be classed as mostly unavailable or, if no available forage is present, as unavailable.

In classifying browse plants for degree of hedging, remember that those plants that exhibit a more or less natural shape are classed as lightly hedged, while those that have been hedged so severely that they exhibit poor vigor and short growth are classed as heavily hedged. All others will fall into the moderately hedged class.

It is recognized that no age or form class description will fit all species of shrubs and trees, and that personal bias has room to operate in borderline cases. It will be necessary to develop written standards in the field in order to overcome these weaknesses.

Believe it or not, now we are ready to proceed with measurement of our sample plots. We will record the various kinds of browse plants by species and by age and form class. When we finish with the first sample plot, we will establish another, and another, and another until we have a bare minimum of ten (but preferably twenty or more). Once we have made careful records of the various elements involved in the survey, we will take our record sheets back to the office and start compilation. When we are finished with this mechanical job, we are ready to analyze the data.

Analysis of Data

With the line-point methods, the data on ground cover will be worked up into percentages. We may find that 20 percent of the ground is bare, 30 percent covered with litter, another 30 percent with herbaceous vegetation, and 20 percent with browse plants and other woody vegetation. It may develop that sagebrush makes up 4 percent of the ground cover, bitterbrush 1.5 percent and snowbrush 0.5 percent. These data may be used immediately for comparing the range with other winter ranges. But their chief value will lie in comparisons with the findings of future surveys in order to determine range trends.

In compiling the data from belt or circle-plot transects, the browse species should be grouped into preferred, staple and low value species. The number recorded for each species and for each group should be compiled on an acre basis. This information will form the

base from which future changes can be measured.

We are now ready to analyze the break-down of the form class data.

While many species of browse will produce vigorously under moderate hedging, vigor will decline and production fall of if heavy hedging prevails over a period of years. Deer are reported as being dainty feeders, inclined toward light and scattered browsing (5). There can be no doubt that, pound for pound, the leaves and twigs taken in such fashion, if only on the basis of lower percentage fiber, are more nutritious than are the coarser twigs and stems consumed where shrubs are browsed heavily. Hence, heavy cropping of browse may be evaluated from two perspectives: the effect on the browse plants, and the effect on the browsing animals. With some species of spiny or stiff-stemmed browse, enough leafage is protected within their cage-like growth forms to enable the plants to survive extended periods of severe use. In such cases, either because of an actual shortage of critical forage or because of the lower nutritive value of the plant parts eaten, the browsing animals may show an adverse effect from heavy cropping before there is an actual decline in the browse stand (4). So, whether from a range plant or a range animal standpoint, a high percentage of heavily hedged preferred browse plants spells trouble.

We will break down our form class data into percentages in order to determine what percent of the stand of preferred and staple browse species are heavily hedged, as well as what percent is available to deer. It should be recognized, however, that if deer are at all abundant, some of the shrubs will be heavily hedged. For this reason, we will make an allowance of 15 percent (the most we are willing to sacrifice) for preferred browse and 5 percent for staple browse. Areas on which more than this allowable percentage of browse plants is heavily hedged will be classed as being in "Unsatisfactory" condition, as will areas where the better species have declined to such low occurence that condition ratings must be based on low value forages (13).

A word of warning, though, in the analysis of form and age class data derived from line-point transects. We must not forget that line-point data are indexes and will not necessarily be representative of the actual number of plants in each age and form class. Because the points tend to hit large plants more frequently than small plants, the percentages will commonly be low for seedling and young plants and high for mature plants. If data on actual plant numbers are desired, a belt or circle-plot transect should be used, either as a separate method or in conjunction with line-points.

While we are about it, we may as well finish by analyzing the age class data.

The relative abundance of various age classes of shrubs may

be an expression of site, competition or fire, or it may result from damage by range animals. The absence of one or more age classes from a stand should be cause for deliberation, especially when younger classes are scarce or absent even though the older shrubs are dying out. The effect of climatic cycles, soil erosion, or fire may favor some species at the expense of others. This can result in a fall-off of reproduction in the suppressed species. Stands of vegetation at full density (optimum stands for the site) may lack a representation of younger plants because of severe competition from established vegetation. Species of plants that reseed satisfactorily only after burning represent another group from which young plants may be absent due to a cause other than browsing pressure. But, where ranges are overstocked with deer or other browsers, the younger age group of preferred forage plants are particularly susceptible to losses resulting from over-cropping.

Where the better forage species on any deer range are dying without replacement, the carrying capacity is declining. Whether drought, blight, insects, fire, livestock or deer has caused the decline, measures must be taken to balance food demand with food supply. Otherwise, the increased pressure on the remaining plants will result in further losses. An analysis of the form classes of shrubs on such a range will reveal to what degree browsing has contributed to the present age composition of the shrubs.

In analyzing the age class data then, our chief concern will be to determine whether there are enough seedlings and young plants on the range to fill in behind the decadent plants. If the percentage of these younger shrubs exceeds the percentage of decadent shrubs by more than 5 percentage points, the apparent trend in browse condition is classed as "Upward". For instance, if seedlings and young plants make up 30 percent of a stand of preferred browse, while decadent plants make up 24 percent of the stand, the difference is more than 5 percentage points so the trend is classed as Upward. If the percentage of decadent plants exceeds that of the young age classes by more than 5 percentage points the apparent trend is classed "Downward". Otherwise, the browse condition is considered "Static". Notice, we have used the term "apparent trend". We must wait for a resurvey 3 to 5 years hence to learn the actual trend in condition of the browse range (13).

While apparent trend is usually based upon browse age classes, there are ranges where browse values are declining because of decreasing availability of forage for deer. In such cases, the apparent trend is classed as upward so long as 55 percent or more of the preferred browse falls into the "All Available" class. It is classed as downward if 55 percent or more falls into the "Largely Available" or "Mostly Unavailable" classes. Otherwise the condition is considered static (13).

And so we have made our range inventory. We have a record now of the kinds and amounts and condition of browse plants present

on permanently located sample plots. This record can serve several purposes. We can compare the range with other winter ranges on which surveys have been made. We can learn from this how this particular range fits into the big picture. Also, by comparing the size and the condition of deer and the fawn production and survival on the various ranges with the forage inventory records, we can learn what kinds of range are best for deer. But, most important, we have established benchmarks from which up or down changes in range condition can be measured. In five years or ten, we can go back and re-measure what is actually happening on the winter range.

But suppose our re-survey five years hence shows the range condition has improved or declined during the interval? To make our picture complete, we will wish to know why. We will want to measure other factors so we can learn why the depletion or the improvement occurred.

For one thing, we will need weather records. We should have, also, some measure of annual forage production and of the annual use of the range by deer. To get this, we will need to make yearly checks on browse growth and on range use by browsing animals. We can make these measurements on the same sample plots that we established for the condition and trend survey.

Browse Utilization Surveys

Some game departments have made annual forage utilization surveys an important feature in their deer range management systems. We will use utilization checks only where needed to provide information wanted to solve specific problems. If there is need to determine the relative amounts of forage consumed by livestock and by deer on common use ranges, for instance, utilization surveys will be helpful. But annual fluctuations in forage production, coupled with fluctuations in deer numbers, make forage utilization levels a very insecure base upon which to manage deer.

No, we will turn to condition and trend surveys for guidance in regulating deer population size. We will base management decisions on the effect of use on the condition of the range, rather than upon the use itself. But, because there will be occasions when we will have need for utilization surveys, we will describe three methods which are commonly used. These are the tagged twig method, the marked bush method, and the twig count method. It should be emphasized that these methods are not intended to yield precise measurement of actual volume or weight of forage consumed. Rather the methods yield indices of use which may be correlated with range condition information in order to determine effects of utilization levels on trends, or for other purposes.

Tagged Twig Method

The tagged twig method works best where seasonal growth of

browse tends to be linear. With this method, one to several twig clusters on each bush or tree in the sample are marked with short pieces of brightly colored insulated wire. A measurement is then made of the length of current growth on each twig in the marked cluster (3).

A first measurement is made of the current production after the plant has made full growth in late summer or early fall in order to determine the amount of twigage available for browsing. Only leaders that measure 3/4 inches or more in length are included in the sample. Shorter lateral spurs are ignored. A second measurement is taken just before the start of the next growing season. This is made to determine the amount of twigage removed by browsing up to the end of the growth year.

If browsing takes place during the growing period, it will be necessary to record measurements for uncropped leaders separately from cropped leaders during the first measurement. If browsing during the summer is so heavy that most leaders are cropped at the time of measurement, we will need to protect some plants from browsing so that annual production may be determined. Different plants should be chosen for protection each year. A shrub or tree that has been protected for several years will produce differently from one that is browsed (3).

Good sampling will require distribution of marked twig clusters at different height levels on the shrubs or trees. Usually, each separate twig or leader in the twig cluster is measured to the nearest 1/2, or in some cases to the nearest 1/4 inch in order to determine the total linear growth (3).

It has been found best to mark fresh twig clusters each year, rather than remeasure the same clusters year after year. Under the latter practice, the pattern of growth will become more complex and harder to measure accurately with each successive season. For the same reason, simple rather than complex twig clusters should be chosen for measurement where possible. Often, toward the end of the growth year, it becomes difficult to distinguish the old growth from the current growth. Where twig patterns are simple and well defined, the probabilities of error from this source are much reduced (3).

Marked Bush Method

The marked bush method is a modification of the tagged twig method. With this approach, only bushes or trees, not individual twig clusters, are marked. On each of the marked bushes, twig clusters are grabbed at random, and the current growth on the five twigs nearest the thumb is measured. A total of between 30 and 50 twigs are measured on each bush (8). No effort is made to remeasure

the same twigs when rechecks are made. The number of twigs measured is considered large enough to give a representative sample (13).

All twig measurement methods give best results when browsing occurs after the growth of the year is complete. This, of course, is the case on deer winter ranges, unless livestock use these areas during the summer.

While the data from twig measurement methods is most usually presented as average percentage utilization by plant, by plot, or by range, there is a great advantage in expressing the findings in terms of inches of growth. This is illustrated in Table 1 (12).

Table 1 - Comparison of browse growth and utilization

Year	Average leader length	Amount Consumed	Percentage Utilization
1959	6.0 inches	2.0"	33
1960	3.0 "	2.0"	67

It will be seen in the Table that a fixed demand for food, i.e. 2 inches, can result in a 33 percent utilization one year and a 67 percent utilization another year solely as a result of fluctuations in annual browse production. Where the data is presented solely in terms of percentage utilization, increases or decreases of deer numbers may be inferred that are not warranted by the field facts.

Twig Count Method

The twig count method is a simple operation. Eight or ten twig clusters are chosen at random on each bush. A count is made of the browsed and of the unbrowsed twigs. The percentage of browsed twigs may be used directly as an index of use, or it can be converted into percentage utilization of linear growth, or of weight, by means of correlation curves or tables (13).

In all methods described above, it appears best to eliminate the "mostly unavailable" form class of browse from the sample. Such plants offer only small amounts of available forage and are often only lightly cropped even where the general range use is heavy. The inclusion of such plants may obscure the vital story of what is happening to the range. The younger and available browse plants make up the class of forage which should be protected from over-browsing. It is these plants upon which the future forage supply will depend.

Production Index

We have already stressed that the supply of forage on a range may change greatly from year to year as a result of changes in annual rainfall or in favorable growing weather. An index of forage production is helpful in the evaluation of range trends. Since a poor year or a good year for one browse species is apt to the same for all browse species, measurements of current twig growth on one, or two, important species will be enough for index purposes.

Measurements should be taken from a minimum of ten, and preferably twenty or more, shrubs of each species. The average length of leader or twig growth for the range may be used directly as a growth or production index (3). The index gives a rough measure of the supply of food available for deer each year. This may be compared with the demand for food by deer as shown by pellet group counts.

Pellet-Group Counts

We have made passing reference to pellet-group counts several times in our talks about survey methods. Now it is time to explain what they are about.

Animals in the wild usually are difficult to count because so often they seek to hide from the observer. But the "sign" animals leave on their range remains in place for the trained observer to analyze. Hunters, trappers and stockmen learn early to read animal sign. The presence of fresh deer droppings, for instance, assures the deer hunter that his quarry has been in the area recently. A count of groups of deer droppings, or pellet-groups, informs the deer range manager of deer abundance and browsing pressure (1,9).

Deer pellet-group counts give an excellent index of range use. If there are twice as many groups on one area of range as compared to another, it is a safe bet that the forage removed from the first area was about twice that taken from the second. Regular pellet-group counts made over a period of years will inform the range manager of trends in deer use. A comparison of counts made throughout the winter range will reveal the areas where deer concentrate.

With this method, groups of deer droppings are counted on sample plots. The sample period may be the summer or winter season just ending at the time of count, or it may be the interval from the time a sample plot was cleared of pellets to the time of count.

On seasonal ranges, current pellet-groups can be distinguished from older groups by color and shine and by lack of disintegration. The absence of feeding marks of dung beetles may also help distinguish pellets of the season. It is good practice to place some freshly dropped pellets at the plot marker stake each year for use the following season for comparison with groups of the season.

It is of utmost importance that counts be made during dry weather. Studies have shown it is much harder to distinguish current droppings from those of previous seasons when pellets are wet (6,12).

The clearing of old pellet groups from plots at time of establishment, and after each successive count, is time-consuming but it makes for more accurate results. This practice should not be necessary on seasonal ranges once workers become trained in the method. On yearlong ranges, however, cleared plots may be essential to reliable counts.

Where sheep use the same range as deer, but at different times of year, cleared plots may be used to determine the amount of use by each class of animal. If the range is used in common by sheep and deer during the same season, the best that can be done is a total count indicative of the dual use. There is no reliable way to tell sheep from deer droppings.

Once the counts are made on a range, the data may be averaged and used directly as an index. Or, better, it may be converted to "pellet-groups per acre", a measurement unit that allows rapid comparisons with data from other ranges no matter what the plot size. Or the count data may be converted into "deer days per acre", but this procedure does involve difficulties with conversion rates.

A deer day is the amount of range use ordinarily made by one deer for one day. Ten thousand deer days can mean that 10,000 deer were on the range for one day, or 1,000 deer for ten days, or 100 deer for a hundred days. But, if we know the number of days the deer were on the range, or the number since the sample plots were cleared, we can divide this into the total deer days to derive the approximate number of animals involved.

A conversion rate of 13 pellet groups per day is in common use. Pellet-group counts in an early study in Utah, made on fenced browse range with known numbers of deer, indicated that the animals defecated an average of 12.7 times in twenty-four hours (11). Later investigations have shown the frequency of defecation varies with the kind, quantity and succulence of food. A conversion rate of 13 has been recommended for use on winter range on which browsing is heavy, and one of 15 where use is moderate (6,11,12).

The sample plot used for pellet-group counts works best where it is a multiple of an acre so to allow easy computation to an acreage basis. If it is planned to convert counts to deer days per acre, a 1/13th acre belt transect has decided advantages in that each group counted may be considered as one deer day per acre on ranges where a conversion rate of 13 is used. On other ranges, a 1/15th acre size plot will offer the same advantage.

The opportunity for making supplemental counts of cattle droppings, or of the droppings of horses, antelope, elk or rabbits,

should not be over-looked. Such counts are useful to show range pressures by different classes of animals.

It should be pointed out that pellet-group counts on circular plots sometimes yield higher results than do those from belt transects. Possibly, this difference is derived from the closer observation given smaller plots, or it may result from the much weightier effect of borderline groups in conversion of small plot data to a per-acre basis. The importance of using equal care in counting large belt transects is obvious. There is especial need for careful judgment in counting pellet-groups that fall along plot margins. Only those marginal groups should be counted of which more than half the individual pellets occur within the sample plot. The inaccuracies involved in mixing different kinds of sample plots (viz. belts and circles) on one sample unit should be avoided.

Since it is our plan to use pellet-group counts directly as an index of use by deer, and because we do not plan to convert the counts into population data, we need not be concerned with the many sources of error that can affect population determinations.

It is good practice to write pellet-group count data directly on a map of the unit at approximate counting locations. In this way, deer use patterns will be revealed and concentration areas located.

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This completes our survey. Let's enumerate our findings:

An inventory of the vegetation and of its current condition.

An annual measurement of the deer food supply.

An annual measurement of range use by deer and other animals.

Where needed, a check of forage utilization by livestock and by deer.

A condition and trend survey every five years or so to learn what the effect of the current level of use has had on the range resource.

Practical Big Game Range Survey Methods

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