

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
Regional Forester



R-4 RANGE ANALYSIS HANDBOOK

CHAPTER 10

RANGE ANALYSIS PROCEDURES

Contents

10.1	Objectives of Range Analysis
11	RANGE ANALYSIS PROCEDURE
11.1	Determination of Basic Ecology
11.2	Mapping
11.3	Determination of Tentative Grazing Capacity
11.4	Determination of Trend
11.5	Development of Management Plans
12	ORGANIZATION OF THE RANGE ANALYSIS PROCEDURES
12.1	Become Familiar with the Allotment
12.2	Mapping
12.3	Weight Estimate or Ocular Analysis as a Basis for Range Condition Classification and as a Check on Suitability
12.4	Select Permanent Bench Marks on Primary Range
12.5	Firm Up Suitability
12.6	Compile Data
12.7	Estimate Grazing Capacity
12.8	Prepare Management Plans
12.9	Firm Up Grazing Capacity Estimates
13	PHOTOGRAPHS



R-4 RANGE ANALYSIS HANDBOOK

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

R-4 RANGE ANALYSIS HANDBOOK

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.

R-4 RANGE ANALYSIS HANDBOOK

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).

R-4 RANGE ANALYSIS HANDBOOK

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 2213.

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).

R-4 RANGE ANALYSIS HANDBOOK

CHAPTER 20

MAPPING

Contents

21	ANALYSIS MAPPING
22	PREPARATORY WORK
23	FIELD WORK
23.1	Vegetational Types
23.2	Mapping Range Suitability
23.3	Mapping Range Condition
23.4	Mapping Apparent Trend
23.5	Mapping Suitability on Common Use Allotments
24	RANGE ANALYSIS MAP SYMBOLS
25	COMPLETION OF THE MAPPING PROGRAM
25.1	Steps for Completion of Map
25.2	Coloring Completed Map



R-4 RANGE ANALYSIS HANDBOOK

CHAPTER 20 MAPPING

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

1. A map will be prepared for each grazing allotment showing vegetal types, range suitable for domestic livestock grazing, and range condition and trend.
2. Field mapping will be done on aerial photographs. These photos will be sent to the Regional Office Division of Engineering for transfer of data to a planimetric base. This transfer may be completed on the National Forests where facilities are available.
3. 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 the top of the priority list.
4. 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.

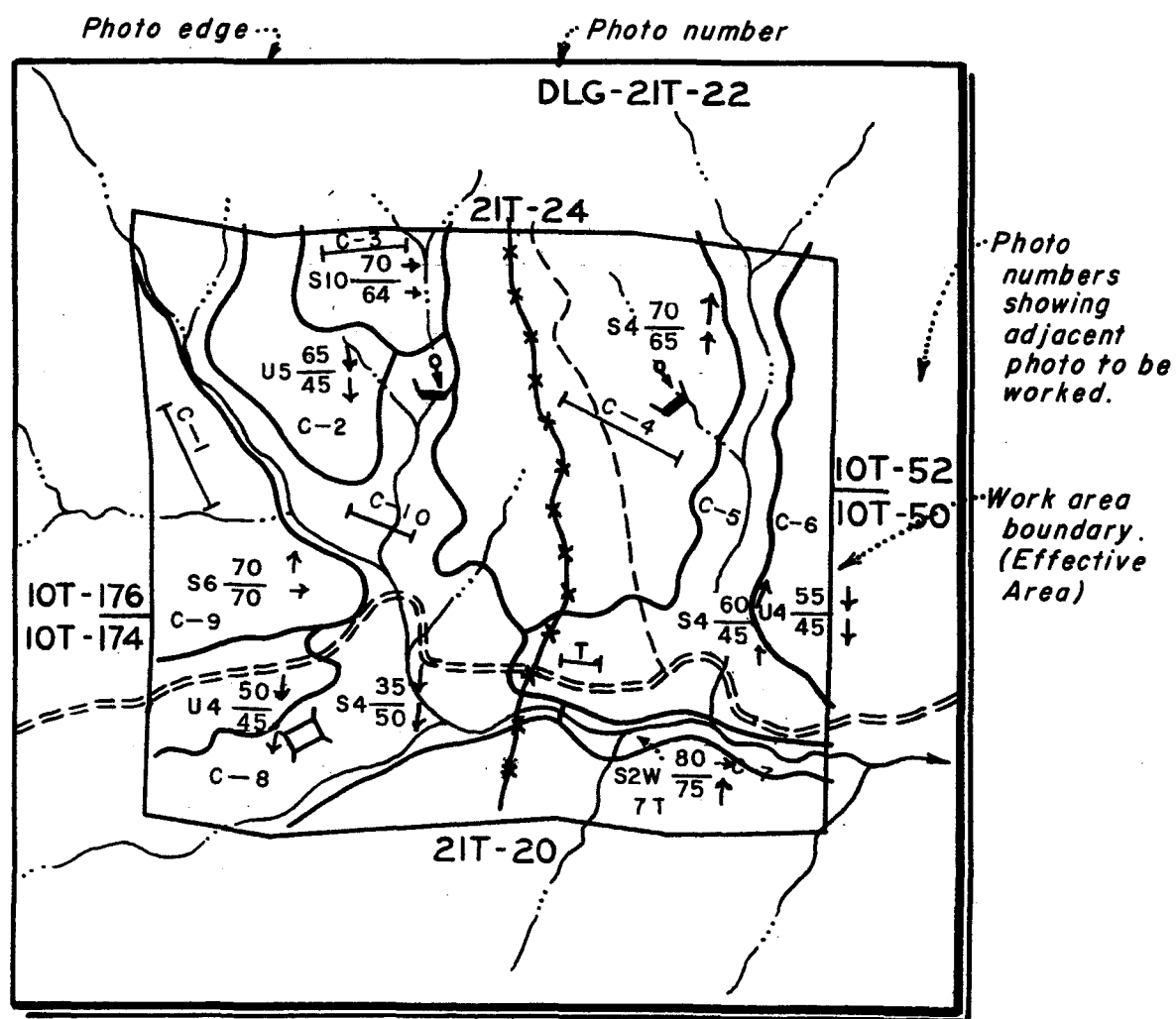
22 — PREPARATORY WORK. The following preparatory work should be done in the office prior to the field season:

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.
3. Accurately locate allotment boundaries on photos by use of a stereoscope. Indicate boundary with a solid green line. (See Exhibit 22 for example.)

R-4 RANGE ANALYSIS HANDBOOK

Exhibit 22

EXAMPLE OF MAPPING ON AERIAL PHOTOGRAPHS



R-4 RANGE ANALYSIS HANDBOOK

23 — FIELD WORK. A map will be made of each allotment showing types of vegetation, the area suitable for use by domestic livestock, and the condition and apparent trend of the soil and vegetation. Symbols showing range improvements, seeded and sprayed areas 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, vegetational type, and range condition classes. A 3-unit symbol will be used to denote suitability, vegetational type, and range condition. Trend will be shown with arrows. As a general rule, 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 estimate the percentage in each classification. Lumping types in this fashion should be used only when absolutely necessary.

The kind of livestock using an area will be considered in determining range suitability. On common use ranges, separate suitability maps for each kind of livestock will be made.

23.1 — Vegetational 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 dominates 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: oakbrush, mountain mahogany, bitterbrush, willow ceanothus, etc.
- 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.

R-4 RANGE ANALYSIS HANDBOOK

- 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 per acre dry weight 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.

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 and secondary 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 under attainable management 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.

(S) — *Secondary Range.* This is land suitable for livestock use from the standpoint of slope, soil stability, and forage production, but which is 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 become primary range by overcoming deficiencies which limit or prevent use.

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 be mapped in three categories with the following symbols used:

U — Unsuitable Range Used.

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

R-4 RANGE ANALYSIS HANDBOOK

Nonrange — Lands which in their pristine state produce less than 50 pounds of dry forage per acre are classed as nonrange areas. Such lands are typed as:

7t— for heavy timber types.

7 — for other types which contribute little or no forage to either domestic stock or big game.

8 — for barren areas.

See Chapter 30 for detailed discussion of suitability.

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 is 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.

All suitable range will be classified as to condition. In addition, range that appears to be unsuitable will be classified as to condition where it is necessary to correlate live-stock and other resource uses or where condition determination is basic in determining suitability. Types 7 and 8 will not be classified as to condition.

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

23.4 — Mapping Apparent Trend. Apparent trend in soil stability and vegetation will be judged separately for each classified area. 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 41.28-D, 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 different symbol is required, write it under the cattle symbol, also in brown. For example, the symbol for the classification for cattle might be $N5 \frac{60 \rightarrow}{50 \rightarrow}$. This would indicate a browse-sheep range "Unsuitable Not Used" for cattle, fair vegetal condition, and fair soil condition, trends not apparent. This same area for sheep might be typed $S5 \frac{60 \rightarrow}{50 \rightarrow}$. This would indicate it suitable for sheep. For

the combined classification show a brown "S" under the "N"; thus, $N5 \frac{60 \rightarrow}{S5 \frac{60 \rightarrow}{50 \rightarrow}}$. Photo thus mapped will furnish information for making two separate suitability maps — one for each kind of livestock.

R-4 RANGE ANALYSIS HANDBOOK

24 — RANGE ANALYSIS MAP SYMBOLS.

Range Suitability

- S — Primary Range
- C — Suitable Range
Closed
- (S) — Secondary 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

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 $\frac{35}{36}$ → — Unsuitable grassland range being used with the vegetation in poor condition with no apparent trend and the soil stability in poor condition with a downward trend.

S_{2w} $\frac{65}{82}$ ↑ — Suitable wet meadow in good condition with the vegetation showing an upward trend and soil stability excellent with no apparent trend.

7 — Heavy timber or brush (suitability and condition ratings will not be made for vegetational types classified as nonrange or barren).

R-4 RANGE ANALYSIS HANDBOOK

The following symbols will be standard for mapping on photos:

Basic Typing Units

Allotment Boundary

*Color*

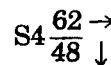
Green

Type Boundary



Black

Range Classification



Black

Permanent Streams



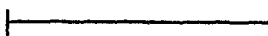
Blue

Springs



Blue

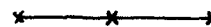
Site Analysis Transect



Red

Existing Range Improvements and Permanent Study Locations (All shown in black on photos)

Fences



Water Development



Reservoirs



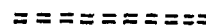
Reseeding



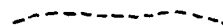
Sprayed Areas



Roads



Trails



Bench Mark — Location and Number



Permanent Trend Transect



Permanent Camera Points



Study Exclosure



Private Land



Intermittent Stream



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.

R-4 RANGE ANALYSIS HANDBOOK

25 — COMPLETION OF THE MAPPING PROGRAM

25.1 — Steps for Completion of 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 allotment boundaries and other important features are properly located on the photos. Ink the photos, as they should be kept as permanent working records.

2. Where private land is involved, known section corners, land monuments, mining claim monuments, and private property corners should be pinpointed on photos. Even two definite locations would be of great help to Engineering in delineating the private lands.

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

3. If there is a photogrammetrist on the National Forest, the range analysis maps will be made in the Supervisor's Office. When this service is not available on that unit, the range analysis data will be sent to the Regional Forester. The following procedures should be followed in sending range analysis mapping work to the Regional Forester.

a. Complete form R4-5600-138 and send two copies plus the requested material listed on the form to the Regional Forester.

b. Send sufficient photos for complete stereocoverage of the allotment. Check the ends of the flight lines to assure stereocoverage in these areas.

c. Upon receipt of form R4-5600-138, 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, it 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 personnel 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 will have need for the aerial photos between the date of submission to Engineering and the date the data transferring work will commence, the following alternate procedure will be followed:

(1) Submit completed form R4-5600-138 but after the heading "The following photo coverage" on the form, write the following statement: "Photos retained until requested."

(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. Engineering will transfer data to the map and return a rough draft copy plus the aerial photos to the National Forest for correction.

R-4 RANGE ANALYSIS HANDBOOK

5. The Forest Supervisor will correct the rough draft map and return it to the Regional Forester for final prints. In correcting the rough draft map, the following procedure is to be followed:

a. Corrections should be made on the rough draft map in colored pencil or ink with red used for additions and blue for deletions.

b. The corrections must also be made on the aerial photos in black ink and the photos returned to Engineering along with the corrected rough draft map for preparation of the final map.

c. Location of natural water will be shown on analysis maps through the use of permanent and intermittent stream symbols if such features are indicated in blue during the field mapping work on the aerial photos, or indicated as corrections on the rough draft map.

d. If additional geographic names or changes in present names are desired, follow the procedures outlined in FSM 5667.

6. Ten copies of the completed map will be sent to the National Forest and financed from Division of Range Management funds. Additional copies will be ordered and financed by the Forest Supervisor. Base maps without allotment analysis data should be ordered from the photo reproduction section on a standard requisition form R4-6500-42.

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

1. Condition will be shown in solid colors as follows: Excellent (dark green), Good (light green), Fair (orange), Poor (yellow), and Very Poor (red). Vegetational types 7 and 8 (uncolored).

2. Suitability may be indicated by hachures and crosshachures on condition maps which are colored (providing hachures will not impair map readability), 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), Vegetational Types 7 and 8 (purple).

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

1 — Grassland	— Yellow
2w — Wet Meadows	— Orange
2d — Dry Meadows	— Orange
3 — Perennial Forbs	— Lake red
4 — Sagebrush	— Brown
5 — Browse-shrub	— Olive green
6 — Coniferous Timber	— Dark green
7t — Heavy Timber	— Blue green
7 — Other	— Blue green
8 — Barren	— Uncolored
9 — Pinyon-Juniper	— Light green
10 — Broadleaf Trees	— Pink



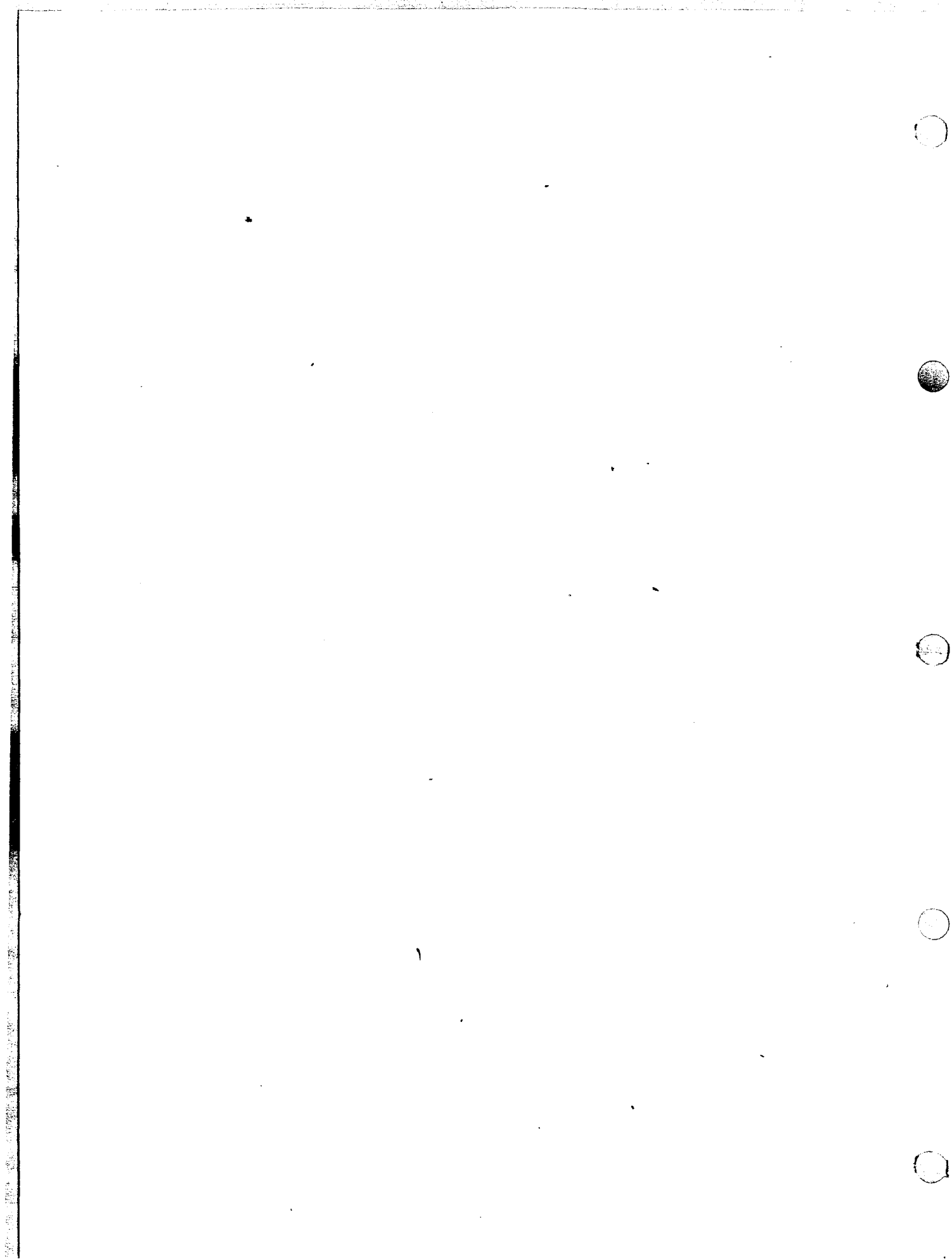
R-4 RANGE ANALYSIS HANDBOOK

CHAPTER 30

SUITABILITY, CONDITION, AND APPARENT TREND

Contents

31	RANGE SUITABILITY
31.1	Basic Principles Governing Range Suitability
31.2	Classification of Range Suitability
31.3	Standards and Guides for Suitability Classification
32	RANGE CONDITION
32.1	Condition Based on Vegetation
32.2	Condition Based on Soil
33	GENERAL INDICATORS OF APPARENT TREND IN RANGE CONDITION
33.1	Soil Indicators of Downward Trend
33.2	Soil Indicators of Upward Trend
33.3	Plant Indicators of Downward Trend
33.4	Plant Indicators of Upward Trend
34	GENERAL CONDITION STANDARDS
34.1	Condition Standards for Big Sagebrush
34.2	Condition Standards for Aspen Ranges
34.3	Condition Standards for Alpine Ranges
34.4	Condition Standards for Tall Forb Ranges



R-4 RANGE ANALYSIS HANDBOOK

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. Thus, 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

R-4 RANGE ANALYSIS HANDBOOK

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 classification 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 $2\frac{1}{2}$ 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

R-4 RANGE ANALYSIS HANDBOOK

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 gullyng 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.

R-4 RANGE ANALYSIS HANDBOOK

Exhibit 31.1

LITERATURE CITED

- (1) Annual Report.
1950. USDA, Intermountain Forest and Range Expt. Sta. p.64
- (2) Annual Report.
1959. USDA, Intermountain Forest and Range Expt. Sta.
- (3) Annual Report.
1961. USDA, Intermountain Forest and Range Expt. Sta.
- (4) Forsling, C. L.
1931. A study of the influence of herbaceous plant cover on surface runoff and soil erosion in relation to grazing on the Wasatch Plateau in Utah. U. S. Dept. Agr. Tech. Bul. 220.
- (5) Lewis, Mont E.
1936. Sheep management on the East Cassia division of the Minidoka National Forest. Unpublished master thesis. Univ. Idaho, Moscow, Idaho.
- (6) Marston, Richard B.
1952. Ground cover requirements for summer storm runoff control on aspen sites in northern Utah. Jour. Forestry 50: 303-307.
- (7) Meeuwig, R. O.
1960. Watersheds A and B — A study of surface runoff and erosion in the sub-alpine zone of central Utah. Jour. Forestry 51: 28-31.
- (8) Orr, Howard K.
1957. Effects of plowing and seeding on some forage production and hydrologic characteristics of a subalpine range in central Utah. USDA, Intermountain Forest and Range Expt. Sta. Res. Paper 47.
- (9) Packer, Paul E.
1951. Status of research on watershed protection and requirements for granitic mountain soils in southwestern Idaho. USDA, Intermountain Forest and Range Expt. Sta. Res. Paper 27.
- (10)
1953. Effects of trampling disturbance on watershed condition, runoff and erosion. Jour. Forestry 51: 28-31.
- (11) Stoddart, Laurence A. and Smith, Arthur D.
1955. Range Management, McGraw-Hill Book Company, New York.
- (12) Talbot, M. W.
1926. Range watering places in the Southwest. U.S. Dept. Agr. Bul. 1358.

R-4 RANGE ANALYSIS HANDBOOK

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 $2\frac{1}{2}$ miles to water, on mountainous terrain this would be reduced to $\frac{1}{2}$ 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.

R-4 RANGE ANALYSIS HANDBOOK

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 characteristics 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

R-4 RANGE ANALYSIS HANDBOOK

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

S A M P L E

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 percent 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

S A M P L E

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 $\frac{1}{2}$ mile
 9. Low potential range N or U
 9. Moderate to high potential range (S)
 10. Distance from water less than $\frac{1}{2}$ 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

R-4 RANGE ANALYSIS HANDBOOK

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.

R-4 RANGE ANALYSIS HANDBOOK

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.

R-4 RANGE ANALYSIS HANDBOOK

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.



R-4 RANGE ANALYSIS HANDBOOK

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.)

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

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

R-4 RANGE ANALYSIS HANDBOOK

CHAPTER 40 SITE ANALYSIS

Contents

41	WEIGHT ESTIMATE SITE ANALYSIS
41.1	Laying Out the Transects
41.2	Instructions for Recording Information on Site Analysis, Form R4-2200-13
41.21	Determining Forage Production, Forage Utilization, and Percent Composition
41.22	Overstory Vegetal Cover
41.23	Ground Cover Determination
41.24	Soil Disturbance — Displacement and Compaction
41.25	Use Intensity Determinations
41.26	Soil and Erosion Data
41.27	Cover Dispersion
41.28	Rating Condition and Apparent Trend
41.3	Site Analysis Transect Summary
42	OCULAR ANALYSIS
42.1	Steps to Take in Running an Ocular Analysis



R-4 RANGE ANALYSIS HANDBOOK

CHAPTER 40
SITE ANALYSIS

Site analysis and ocular analysis are used as a basis for condition classification and as a check on suitability. With the exception of types 7 and 8, each classified area within the allotment will be analyzed. At least one out of five classifications must be supported by weight estimate site analysis transects (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 weight estimate transects. However, he should not increase the proportion of ocular analysis.

Location of all weight estimate site analysis transects will be plotted in red ink on the aerial photographs. Each classification on the allotment will be identified on the photograph by the writeup number from either form R4-2200-13 or R4-2200-10. Writeup numbers will identify the examiner by the first letter of his last name followed by the transect number; examples, J-1, J-2, etc. Place the writeup number on the aerial photograph in red. Start a new set of numbers for each allotment.

41 - WEIGHT ESTIMATE 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 weight estimate transects in several different classifications to be analyzed on the allotment. Following these preliminary runs, he will proceed through the allotment making a weight estimate site analysis in at least every fifth classification. Measurable factors will include vegetal composition, forage production, forage utilization, percent vegetal and litter cover, bare ground, soil disturbance, and soil erosion. Parent material of soil and soil structure 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 for equipment needed.

R-4 RANGE ANALYSIS HANDBOOK

Exhibit 41

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 —
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.

R-4 RANGE ANALYSIS HANDBOOK

41.1 - Laying Out the Transects.

1. *Uniform Sites.* Strive for uniformity in the selection of the sites being sampled. Confine each sample to a single plant community.

2. *Location of Transect Lines.* A transect line should run diagonally across a slope or type to give the best sample.

3. *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, considering the time element as well as degree of accuracy. Recent 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).

4. *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 photo. 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. On small meadows a plot interval of less than a chain may be necessary.

5. *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 size, generally 10 plots should be used per transect, except in real sparse or clumpy vegetation where 20 plots will be used.

6. *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 41.2)

R-4 RANGE ANALYSIS HANDBOOK

41.21 - 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 41.21-A.) 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 $\frac{1}{2}$ gram and 1 gram will be recorded as a gram; weight estimates less than $\frac{1}{2}$ 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 41.21-B 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.

R-4 RANGE ANALYSIS HANDBOOK

9. *Desirability Rating.* Desirability rating of the species will be based on the appropriate species list. (See Exhibits 41.21-C or 41.21-D.) 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.

R-4 RANGE ANALYSIS HANDBOOK

DOMESTIC LIVESTOCK AND FORAGE REMOVAL

Estimated 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:

$$\frac{\text{No. per A.} \times \text{Sheep days use}}{13} = \frac{\text{No. Per A.} \times \text{Sheep months use}}{390}$$

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 1/2 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 permitted 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.

$$\text{Formula: } \frac{\text{No. Per Acre} \times \text{Cattle days use}}{12} = \frac{\text{No. per Acre} \times \text{Cattle months use}}{360}$$

R-4 RANGE ANALYSIS HANDBOOK

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:

$$\frac{\text{No. Per Acre} \times \text{Deer days use}}{13} = \frac{\text{No. Per Acre} \times \text{Deer months use}}{390}$$

2. Based on review of numerous feeding studies and determination of average herd run weights.

R-4 RANGE ANALYSIS HANDBOOK

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. Photo plot studies
4. Exclosures
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 unit on his District. Any data gathered previous to designating the herd unit and starting the big-game range analysis should be filed in the above designated folder and cross-referenced 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).

R-4 RANGE ANALYSIS HANDBOOK

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 classfile folder and filed under the following designation:

Example: 2620 Planning
(Surveys, Studies, Plans)
Big-Game Range Analysis
South Fork Deer Herd

Herd unit classfile 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

R-4 RANGE ANALYSIS HANDBOOK

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.

R-4 RANGE ANALYSIS HANDBOOK

PELLET-GROUP COUNT RECORD

Exhibit 95.31

(Forest) (Ranger District)				(Transect Name and Number)													
(Game Herd)				(Area)													
(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 acres³ counted (no plots x size of plot).....
4. Pellet groups per acre $\frac{\text{(total pellet groups)}}{\text{(total acres counted)}}$
5. Days per acre² (pellet groups per acre).....
 $\frac{\text{(13 (game) or 12 (cattle))}}{\text{.....}}$
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)

R-4 RANGE ANALYSIS HANDBOOK

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 99 ft. 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

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.

R-4 RANGE ANALYSIS HANDBOOK

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.

R-4 RANGE ANALYSIS HANDBOOK

Fall

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.

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.

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.

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).

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 \div total number) of twigs measured is to be calculated. (If summer use has occurred include the estimated total inches removed to determine total growth.)

Spring

1. The length of remaining current twig growth on the tagged branch is measured and recorded as in the fall.

2. The remaining current growth in inches is tallied for each branch and totaled for the entire transect.

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. Examination of leaders out of reach or protected from grazing will aid in training to separate current from previous years' 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.

Date	Observer	Species	Date	Observer
------	----------	---------	------	----------

(% Utilization) Game _____ Livestock _____ Ave. Twig Growth _____ (Days Use/Acre) Game _____ Livestock _____
Total _____ (Game and Livestock)

R-4 RANGE ANALYSIS HANDBOOK

BROWSE UTILIZATION FIELD NOTES

Exhibit 95.11-B

Plant Species _____				
Bush & Tag No. _____		Date _____		
Shoot Length Inches	Before Browsing		After Browsing	
	Number of Shoots	Total Growth Inches	Number of Shoots	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		After Browsing	
	Number of Shoots	Total Growth Inches	Number of Shoots	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		After Browsing	
	Number of Shoots	Total Growth Inches	Number of Shoots	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		After Browsing	
	Number of Shoots	Total Growth Inches	Number of Shoots	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:

R-4 RANGE ANALYSIS HANDBOOK

BROWSE UTILIZATION SUMMARY SHEET

Exhibit 95.11-A

Forest _____
 District _____
 No. & Name of Game Herd _____
 Examiner _____
 Location of Transect _____
 Aerial Photo No. _____
 Plant Species Tagged _____
 Specify Year of Growth Measured (current or old growth) _____
 Date Examined: _____
 Before Browsing _____
 After Browsing _____

Period of Use	% Utilization
Deer	
Elk	
Cattle	
Sheep	
Other	

[illegible]

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:
- | <u>All available</u> | <u>Largely available</u> |
|-------------------------|--------------------------|
| 1. Little or no hedging | 4. Little or no hedging |
| 2. Moderately hedged | 5. Moderately hedged |
| 3. Closely hedged | 6. Closely hedged |
| | 7. Mostly unavailable |
| | 8. Unavailable |
- 3/ Age classes: S = Seedling, Y = Young plant, D = Decadent plant, M = Mature plant
- 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.

R-4 RANGE ANALYSIS HANDBOOK

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:

R-4 RANGE ANALYSIS HANDBOOK

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.

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 Caliche 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 1/3 of the type

INHERENT EROSION HAZARD: DETACHABILITY RATING 7; SURFACE COVERED WITH ROCK FRAGMENTS $\frac{1}{2}$ INCH OR GREATER
 IN DIAMETER 0 %; ADJUSTED DETACHABILITY RATING 7
 PROFILE PERMEABILITY RATING 7; SOIL ERODIBILITY INDEX 49; CLASS II
 SLOPE 35-40 %; INHERENT EROSION HAZARD, CLASS II

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

COVER DISPERSION: UNIFORM — FAIRLY UNIFORM V 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

MUST 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

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

R-4 RANGE ANALYSIS HANDBOOK

Exhibit 93.3-A

SITE ANALYSIS

WRITE-UP NO. T-4						PHOTO NO. CV12-911-15			
FOREST Bannock		RANGER DISTRICT Indian Head		ALLOTMENT Coyote Creek		EXAMINER Wm. Thompson		DATE 5/14/63	
TRANSECT NO. 1 of 1	PLOT SIZE 9.6	PLOT INTERVAL 1 ch		TYPE DESIGNATION S5		KIND OF LIVESTOCK Sheep		SLOPE 35%	ASPECT W
LOCATION In the head of Birch Cr.									ELEVATION 9,500

SPECIES	PLOTS										TOTAL PROD.	GRAMS USED	% UTIL.	DRY WT. PROD.	PCT. COMPO.	DESIRABILITY RATING	
	1	2	3	4	5	6	7	8	9	10							
GRASSES																	
<i>Braa</i>	20		1		5	5	5	5	4	3	48			12	1	D	
<i>Agr</i>	12	20	2			4	10	10	15	5	78			39	2	D	
<i>Meku</i>		3	1								4			12	T	D	
<i>Stla</i>					40						40			20	1	I	
<i>Pore</i>			2								2			1	T	D	
Total grass											172			85	4		
FORBS																	
<i>Paco</i>	110	110	40	3		45	25	70	4	100	509			15%	9	D-5.3	
<i>Hafi</i>	15	25	8		2	14				10	200			1.0	L	D	
<i>Coli</i>	4		1	5						6	16			5	T	I	
<i>Stja</i>	5	5	3	4	4	6	18		4		49			15	1	I	
<i>Kipu</i>	3	15	4	3	8	15	20	10	4	15	97			29	2	I	
<i>Agpu</i>	3										3			1	T	L	
<i>Tafe</i>	8	5		5		35	15				68			20	1	I	
<i>Acla</i>	4					10					14			4	T	I	
<i>Paga</i>	2		5	20	3		15		6		57			15	1	I	
<i>Chal</i>		5						3			8			2	T	I	
<i>Dein</i>		3	4	8	2		8	15	6	15	61			18	1	I	
<i>Magl</i>			1	25	20					40	86			26	2	L	
<i>Dehr</i>			T								T			T			
<i>Lual</i>					6						6			2	T	D	
<i>Actz</i>					3						3			1	T	I	
<i>Heho</i>						70					70			21	1	L	
<i>Pofi</i>						6					6			1	T	I	
<i>Vimu</i>	10	35	15	3	8	25	30	30	5	25	186			5%	3	I	
Total forbs											1431			429	25		
BROWSE																	
<i>CRT</i>																	
<i>Artr-P</i>	130										130			65	4	I	
<i>Samz-F</i>	45	450	40	25		810	720	600	60	480	3230			1130	67	D-10.75 L-5.2	
Total browse											3360			1195	71		
Total														1709	100		
% OVERSTORY (TREES)											Average	% DESIRABLE 22					
% OVERSTORY (SHRUB)	20	65	20	15		100	90	85	25	60	53	% INTERMEDIATE 33					
% CROWN COVER (HERB)												% LEAST DESIRABLE 45					
% BARE GROUND	40	15	70	80	30	20	20	35	70	35	44	CONDITION RATING:					
% ROCK & PAV (NAT.)												COMPOSITION RATING 14					
% ROCK & PAV (UNNAT.)												PRODUCTION RATING 22					
% VEG. & LITTER	60	85	30	20	70	80	80	65	30	65	56	FORAGE CONDITION RATING 36					
% SOIL DISTURBANCE												GROUND COVER INDEX 25					
DROPPINGS												CURRENT EROSION INDEX 33					
PELLET GROUPS												SOIL CONDITION RATING 58					

* 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.

R4-2200-13 (5/64)

BROWSE: CONDITION Good APPARENT TREND →

R-4 RANGE ANALYSIS HANDBOOK

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.

R-4 RANGE ANALYSIS HANDBOOK

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 (↑)

R-4 RANGE ANALYSIS HANDBOOK

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.

R-4 RANGE ANALYSIS HANDBOOK

Quga	Quercus gambelii	0-5	6-10	10+
Rhal	Rhamnus alnifolia		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).

R-4 RANGE ANALYSIS HANDBOOK

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+
Amp	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. betuloides	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. scopulorum		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		

R-4 RANGE ANALYSIS HANDBOOK

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	Y1
Artr	Putr

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 $\frac{1}{2}$ " 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

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)

June 1966

Forest Service Handbook

92.21-D

R-4 RANGE ANALYSIS HANDBOOK
HERD UNIT ANALYSIS
Exhibit 92.21-D

92.21-C

[illegible][illegible]

June 1966

92.21-A

[illegible][illegible]

R-4 RANGE ANALYSIS HANDBOOK

HERD UNIT ANALYSIS

Exhibit 92.21

Forest.....		Ranger District		Date.....	
Herd Unit					
Land Area and Approximate Ownership					
Square Miles	Summer		Intermediate		Winter
Acreage					
Land Ownership	*Acres	%	Acres	%	Acres
Forest Service					
BLM					
Private					
State					
Fish & Game Dept.					
Indian Service					
Other					
Totals		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 — 61→ 39↓	Artr→, Putr↓, Amal↓	Putr
K-1 (cont'd)	winter	S 5 — 42↓ 40↓	Putr↑, Samz→, Puvi↑	Putr
Example K-2	summer	S 1 — 48↓ 38↓	Chvi↑, Arca→	Area
Example for elk K-1	winter inter- mediate	U 4 — 63→ 48↓	Putr→, Pope→, Agsp↑	Watershed trampling

R-4 RANGE ANALYSIS HANDBOOK

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.

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 1/2-inch intervals:

Winter	_____	red
Intermediate	_____	light green
Summer	_____	yellow
Yearlong	_____	purple
Waste or non-range	_____	uncolored

Key Area Letter and Number K-1




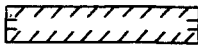

Key area letter and number shown in center of area determined to by key.

Study Designation

U	_____	Browse utilization
P	_____	Pellet group transect
LI	_____	Line intercept
3S	_____	Parker 3-Step
E	_____	Exclosure
CP	_____	Camera point
X—X—X		Fence

Condition Numerical Rating

81-100—excellent
 61-80 —good
 41-60 —fair
 21-40 —poor
 20 or less—very poor

_____	Water development
	Reservoir
	Spring
	Quadrant
	Private land
	Rehabilitation area

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

R-4 RANGE ANALYSIS HANDBOOK

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

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 analysis.

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.

R-4 RANGE ANALYSIS HANDBOOK

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.

R-4 RANGE ANALYSIS HANDBOOK

CHAPTER 90

BIG-GAME RANGE ANALYSIS

Contents

91	OBJECTIVES
91.1	Responsibilities
91.2	Cooperation
92	BIG-GAME RANGE ANALYSIS PROCEDURES
92.1	Minimum Requirements
92.2	Maps and Mapping
92.21	Herd Units
92.22	Seasonal Use Areas
92.23	Key Areas for Big Game
93	BIG-GAME RANGE STUDIES ON KEY AREAS
93.1	3-Step Transects
93.2	Line Intercept Transect
93.3	Condition and Trend
94	FORAGE PRODUCTION STUDIES
94.1	Weight Estimate Method
94.2	Estimated Production
94.3	Allocation of Available Forage to Big Game and Livestock
95	BROWSE UTILIZATION
95.1	Twig Measurement
95.11	Tagged Branches
95.12	Tagged Plants
95.2	Estimates of Utilization on Important Browse Species
95.3	Intensity of Use
95.31	Pellet Group Counts
95.32	Fenced Study Plots
95.33	Use of Utilization Cages
95.4	Other Studies
95.41	Habitat Studies
95.42	Trend Counts
95.43	Hunting Records
96	RECORDING AND ANALYZING HERD UNIT DATA
97	REFERENCES



Full

FOREST SERVICE HANDBOOK

Ogden, Utah

February 29, 1968

TITLE 2212.01 - RANGE ANALYSIS HANDBOOK

REGION 4 AMENDMENT NO. 3

POSTING NOTICE. Amendments to this title are numbered consecutively. Check the last transmittal sheet you received for this title to see that the above amendment number is in sequence. If not, order intervening amendments at once (showing title and amendment number). Do not post this amendment until the missing one(s) is received and posted. After posting, retain this transmittal sheet until the next amendment to this title is received and then destroy. Handbook holders should keep only the last transmittal sheet and should place it at the front of the title.

Post in numerical code sequence in Chapter 90.

<u>Section Code</u>	<u>Pages</u>	
95.11	1	New Material

DIGEST: Browse Utilization Field Sheet.

FLOYD IVERSON
Regional Forester

R-4 RANGE ANALYSIS HANDBOOK

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

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.

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.)

.....
.....
.....
.....
.....
.....

R-4 RANGE ANALYSIS HANDBOOK

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

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 — Enclosures. 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 enclosures 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 enclosure. Some of the smaller enclosures 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 enclosures 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 enclosures.

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-

R-4 RANGE ANALYSIS HANDBOOK

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 resummairize 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 valuable addition to the plot records.

R-4 RANGE ANALYSIS HANDBOOK

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.

R-4 RANGE ANALYSIS HANDBOOK

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.

(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.

(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

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

R-4 RANGE ANALYSIS HANDBOOK

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

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 M₃, D₆, S₁, Y₂, etc. Tally in block directly behind brose species as "ArtrM₂", 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 99 FT. GIVES 1.5/100 ACRE		0 TO 72.6 FT. GIVES 1/100 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.

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. H. 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
		Symz	Putr						
-	-	-	Putr	Acla	Pofa	-	-	P	R
21	22	23	24	25	26	27	28	29	30
	Putr					Arno			
Antz	Pofa	L	L	L	P	L	-	-	P
31	32	33	34	35	36	37	38	39	40
		Arno	Putr			Artr			
L	L	-	Pofa	L	P	L	Antz	Antz	Foid
41	42	43	44	45	46	47	48	49	50
			Symz					Arno	
P	P	-	Erra	-	L	Antz	P	L	Foid
51	52	53	54	55	56	57	58	59	60
P	-	P	Acla	-	Foid	Pofa	Antz	-	-
61	62	63	64	65	66	67	68	69	70
					Symz	Symz	Symz		
L	Erra	-	-	P	-	L	Foid	Antz	P
71	72	73	74	75	76	77	78	79	80
Artr	Antz					Arno	Putr		
L	Acla	-	P	P	-	Pofa	Pofa	L	-
81	82	83	84	85	86	87	88	89	90
Arno							Putr	Artr	
Antz	Erra	L	P	P	P	-	-	-	Antz
91	92	93	94	95	96	97	98	99	100
	Putr			Symz	Arno				
-	L	M	P	Pofa	L	R	P	-	Foid

KEY INDICATOR SPECIES
NOT RECORDED (INCLUDE
UNDESIRABLE INVADERS AND
ANNUALS)

Lupinus
* *Amelanchier alnifolia*
Cirsium sp.
Poa secunda
Balsamorhiza sagittata
* *Castilleja leucodonta*

* VERY SPARSE

VIGOR MEASUREMENTS

SPECIES	Pofa	Foid
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"

BARE SOIL	SYMBOL	SPECIES	PELLET GROUP COUNT
EROSION PAVEMENT	P	(LIST BY SYMBOL, NAME AND NUMBER OF HITS)	PLOT SIZE
ROCK	R		DEER
LITTER	L		ELK
MOSS	M		OTHER
PLANT COVER INDEX	TOTAL		ANNUALS (LIST BY SPECIES)
FORAGE COVER INDEX			INDICATORS
DESIRABLE PLANT INDEX			OTHERS
GROUND COVER INDEX			
OVERSTORY			
UNDERSTORY			

R4-2200-19 (5/64)

OVER
v = seedlings

Total 42.0

R-4 RANGE ANALYSIS HANDBOOK

(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

(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).

20
✓

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.

R-4 RANGE ANALYSIS HANDBOOK

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:

6
Artr
Symz

(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:

10
Putr
P ← Pavement

(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:

Herbaceous	Shrubs
15	10
Potr ₃ Sihy	Sym ₃ Artr
	L

(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.

R-4 RANGE ANALYSIS HANDBOOK

b. *Record of Hits.*

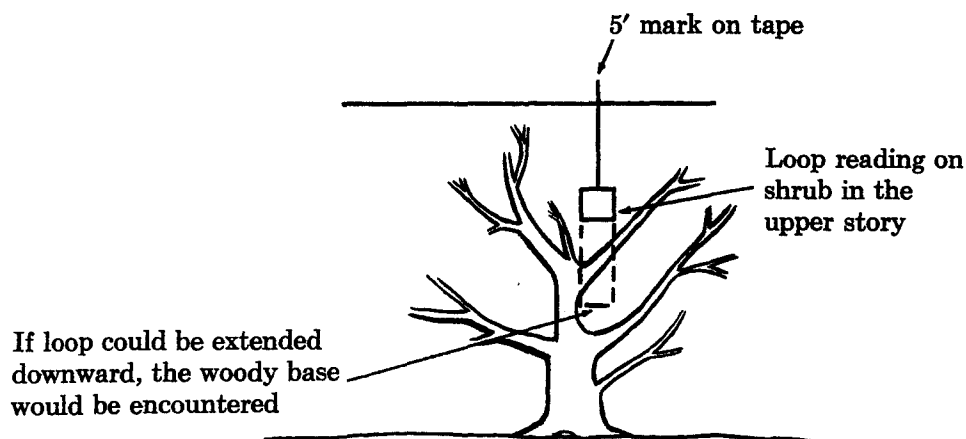
(1) Regardless of the vegetation type sampled, hits on perennial herbaceous vegetation will be shown in the lower half of the block for each foot mark. Example of a hit on *Stipa* at the 50' mark:

50
Stle

(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:

60	or	61
Artr		Artr
Stle		P

(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:

5
Artr
Artr

R-4 RANGE ANALYSIS HANDBOOK

(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 $\frac{3}{4}$ -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 $\frac{1}{8}$ -inch to $\frac{3}{4}$ -inch in diameter, the hit will be recorded as pavement.

(8) *Bare Soil*. Symbol (-). This classification includes all soil particles up to $\frac{1}{8}$ -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).

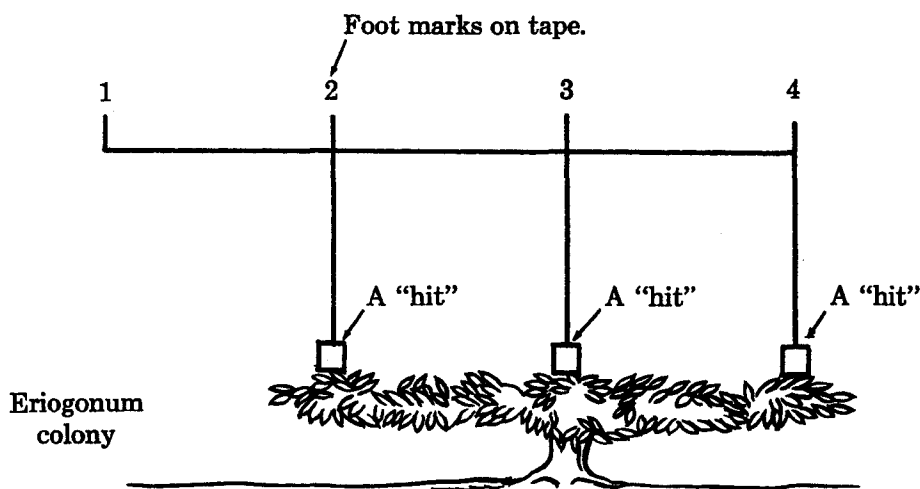
(2) Give bench mark number to transect clusters.

(3) The transect number will be the same as that used on the blackboard to identify line view and plot photographs.

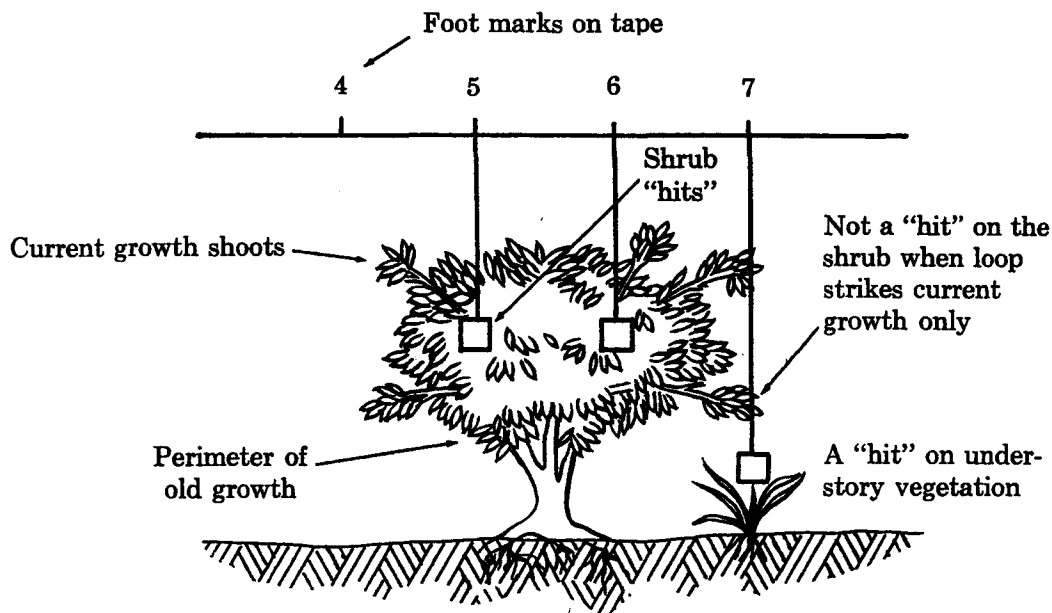
(4) Identity of the worker(s) must be established for present and future needs. They will sign it with their regular signature — not initials.

R-4 RANGE ANALYSIS HANDBOOK

(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.

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 $\frac{3}{4}$ -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.

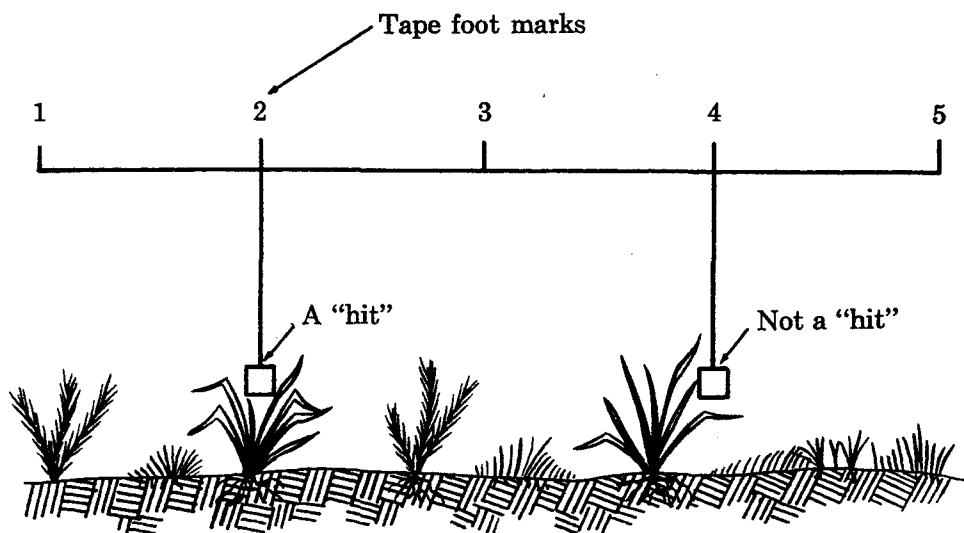
(2) Use of a small plumb bob instead of the loop is recommended where transects sample shrub types or where the tape is more than one foot above the ground. In these situations the following applies:

(a) Plumb bob contact point corresponds to the loop rod position.

(b) Take reading within the limits of $\frac{3}{4}$ -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 $\frac{3}{4}$ -inch loop. See sketch below. At times there will be two or even three species rooted within the loop area.



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

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

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 ($2\frac{1}{4} \times 2\frac{1}{2}$). 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.

Exhibit 81.5

Tape holder rod, leather thong and spring

Tape to be stretched between tapeholder rods, at varying height depending on vegetation type

Take loop readings on the same side stakes are located.

Tapeholder rod and turn buckle for tightening tape

99.5' Angle iron stake

50.5' Angle iron stake

3' x 3' closeup photo plot

33'

0.0' Angle iron stake

0.0' Angle iron is the camera point for PLOT and LINE VIEW photos.

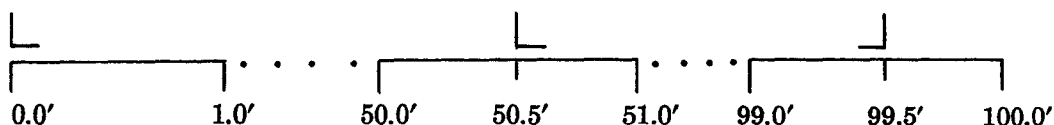
Note drive stakes to extend only 5'-6" above ground, on uphill side of tape. Flat side parallel with tape line. Note angle direction of stakes.

100'

Each 100' Transect samples a plot 100' wide, 150' long.

R-4 RANGE ANALYSIS HANDBOOK

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.

R-4 RANGE ANALYSIS HANDBOOK

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 $3\frac{1}{2}$ feet long and $\frac{5}{8}$ -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 $\frac{3}{4}$ -inch or 1-inch flange. The shorter length is best suited to rocky sites.

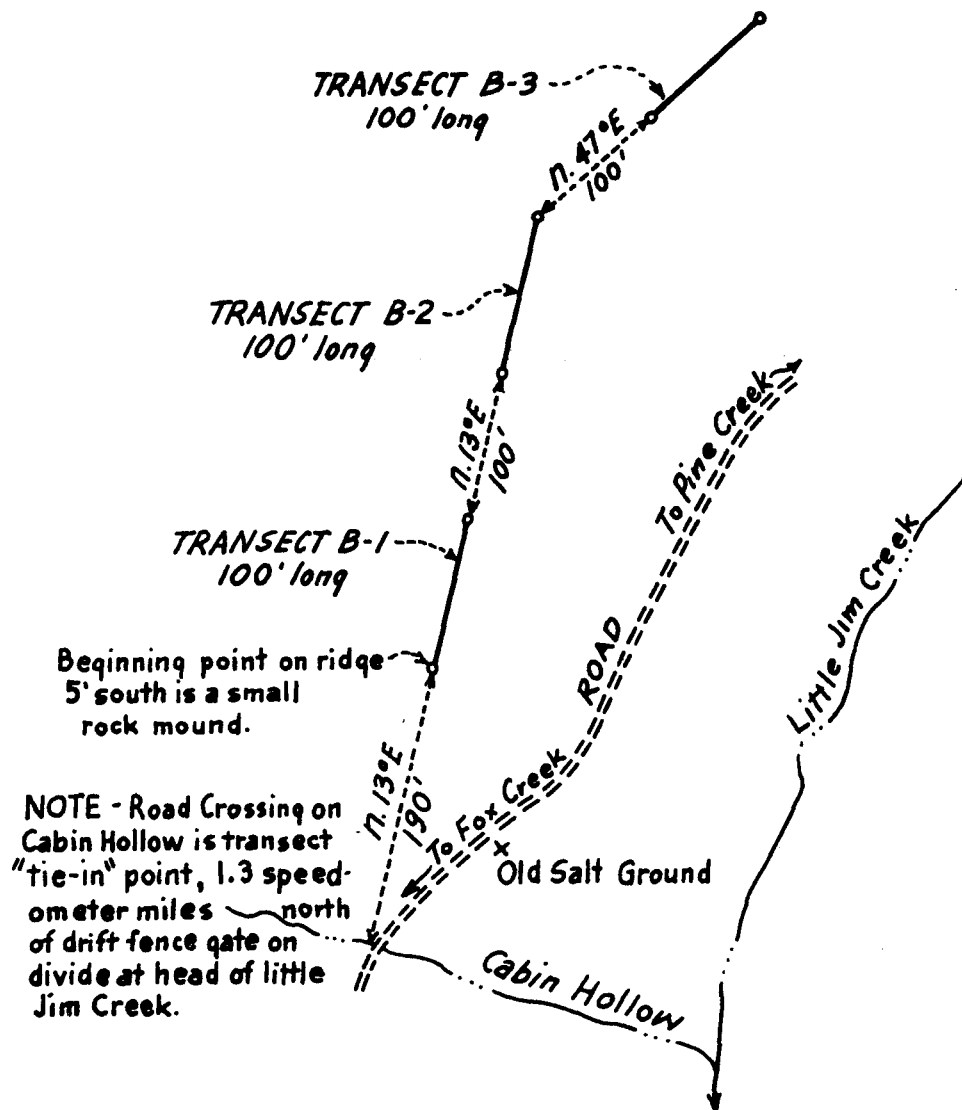
R-4 RANGE ANALYSIS HANDBOOK

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'



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

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

CHAPTER 80

TREND DETERMINATION

Contents

81	ESTABLISHING 3-STEP TREND TRANSECTS
81.1	Number of 3-Step Transects Per Allotment
81.2	Location of Transects
81.3	Number of Transects Per Cluster
81.4	Length of Transects and Arrangement Within a Cluster
81.5	Establishment of Permanent Line Transects
81.6	Photographs
81.7	Reading and Recording Transect Hits
81.8	Line Intercept Measurement
81.9	Summarizing the Transect Data
82	REMEASUREMENT OF 3-STEP TRANSECTS
83	PHOTO PLOT TRANSECTS
84	OTHER ESTABLISHED TREND STUDIES
84.1	Exclosures
84.2	Quadrats
85	USE OF PHOTOGRAPHS IN DETERMINING TREND
85.1	Retakes of Old Photos
85.2	Establishment of Permanent Camera Points on Bench Marks
85.3	Other Camera Points
86	RECHECKING OLD RANGE SURVEYS

R-4 RANGE ANALYSIS HANDBOOK

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. F S M 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.

R-4 RANGE ANALYSIS HANDBOOK

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

¹Use of the unsuitable range should be shown in this column in addition to excessive use of suitable range.

²Show 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.

R-4 RANGE ANALYSIS HANDBOOK

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 — FIRING 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) Utiliza- tion %	(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%	

$$\frac{a}{b} \times 100 = c$$

¹Place 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 case the average use is about 3 percent under proper utilization and the "Under 10%" column has two check marks compared to one for the "Over 10%" column. This indicates a slightly under-utilized unit. It also indicates that distribution could be improved. If these observations were made

R-4 RANGE ANALYSIS HANDBOOK

Exhibit 71.2-C

DRY WEIGHT ALLOWANCE

1. Forage consumption table for cattle.

Cattle	Animal Unit Factor
1,000-lb. animal	1.00
Dry cow	1.00
Cow plus 300-lb. calf	1.36
Cow plus 400-lb. calf	1.46
Cow plus 500-lb. calf	1.55
Yearling	.74

Daily Dry Weight
Consumption

24
24
33
35
37
18

34 #

2. Forage consumption table for sheep.

Sheep	Sheep Unit Factor
125-lb. ewe	1.0
Ewe plus 30 to 40-lb. lamb	1.3
Ewe plus 40 to 50-lb. lamb	1.4
Ewe plus 50 to 60-lb. lamb	1.5
Ewe plus 60 to 70-lb. lamb	1.6
Ewe plus 70 to 80-lb. lamb	1.65
Ewe plus 80 to 90-lb. lamb	1.7
Ewe plus 90 to 100-lb. lamb	1.8
Ewe plus 100 to 110-lb. lamb	1.9

Daily Dry Weight
Consumption

4.1
5.3
5.7
6.2
6.6
6.8
7.0
7.4
7.8

* determined a review of SRS data in 11/3/66

8

July 1964

Forest Service Handbook

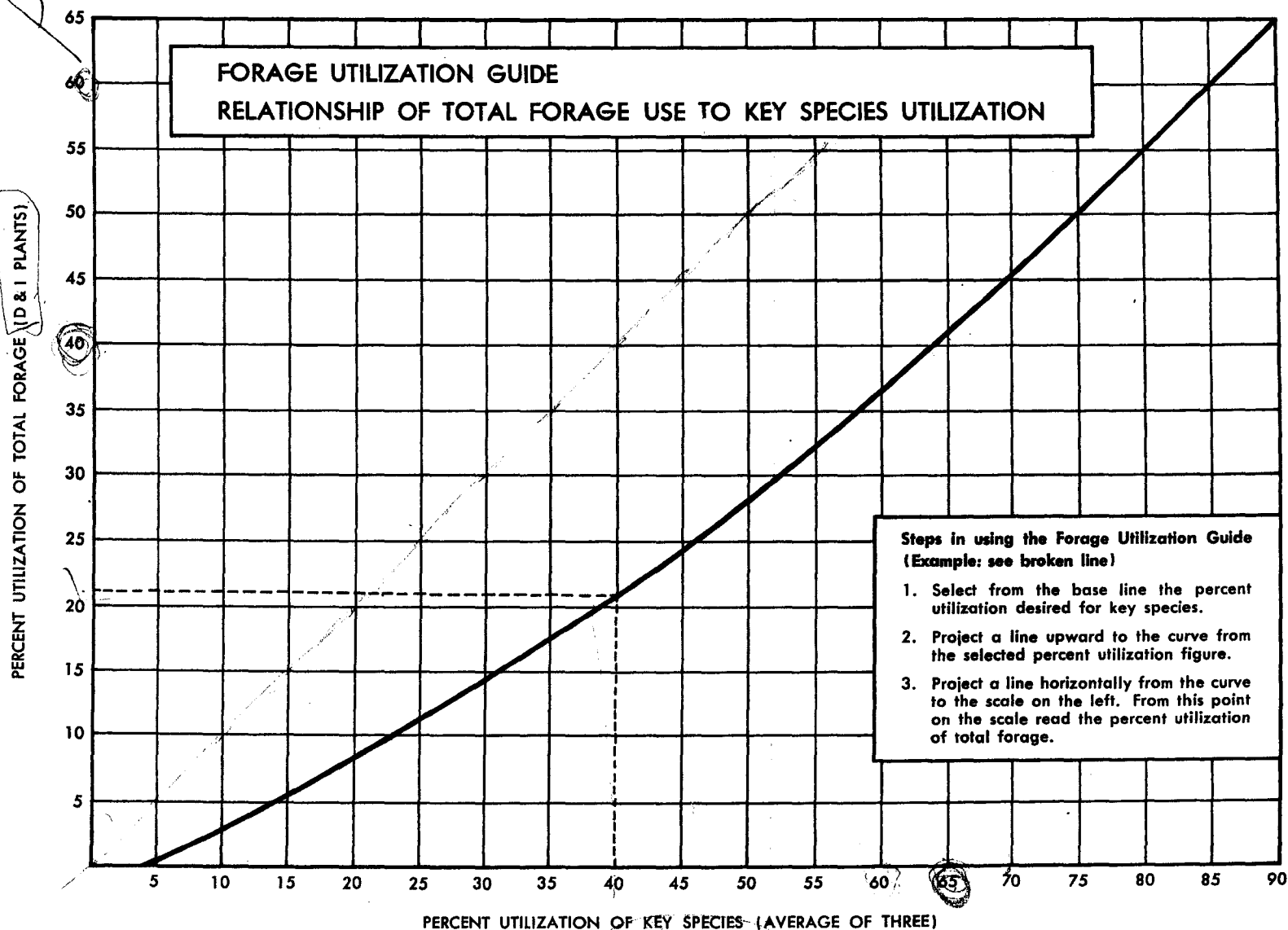


Exhibit 71.2-B

R-4 RANGE ANALYSIS HANDBOOK

71.2-3

R-4 RANGE ANALYSIS HANDBOOK

Exhibit 71.2-A

TENTATIVE GRAZING CAPACITY

UNIT Fall Creek		ALLOTMENT Meadow Valley C&H			FOREST Bannock	RANGER DISTRICT Indian Head		
CLASS OF STOCK Cattle		GRAZING OPERATION Cow and calf			DRY WEIGHT ALLOWANCE 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

*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)

R-4 RANGE ANALYSIS HANDBOOK

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 ($D \times B = E$) 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 — ($A \times F = G$).

R-4 RANGE ANALYSIS HANDBOOK
Exhibit 71.1

ALLOTMENT ANALYSIS COMPILATION SHEET																			Forest:	District:	Allotment:
																			Bannock	White River	Bear Valley Cattle
																			Compiled by:	Date:	N. F. Land or Other:
																			Paul Smith	2/10/64	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 $\frac{38}{28}$	12	2	43														57		
	F-8	S4 $\frac{60}{71}$	31	40	45														116		
	F-11	S2 $\frac{80}{80}$				65	14	215											294		
	F-12	S4 $\frac{28}{36}$					55	70	48	55									228		
	F-15	S1 $\frac{62}{60}$										106	71	105	20				302		
	F-18	S10 $\frac{48}{65}$										45	10	22	29	23			129		
	F-21	S10 $\frac{50}{42}$					110	23	50										183		
	F-24	S5 $\frac{61}{46}$				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 (2)		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 (2)		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)

R-4 RANGE ANALYSIS HANDBOOK

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.

R-4 RANGE ANALYSIS HANDBOOK

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. Present 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.



R-4 RANGE ANALYSIS HANDBOOK

CHAPTER 70

GRAZING CAPACITY DETERMINATION

Contents

71	DETERMINING TENTATIVE GRAZING CAPACITY
71.1	Compilation of the Map Data
71.2	Tabulating Data for Determining Tentative Grazing Capacity
71.3	Forage Allowance for Big Game
72	FIRMING UP GRAZING CAPACITY
72.1	Cattle Range
72.2	Sheep Range
73	FURTHER CONSIDERATION OF GRAZING CAPACITY ESTIMATES
74	POTENTIAL CAPACITY
75	PERMANENT PRODUCTION TRANSECTS
75.1	Layout Transect
75.2	Yearly Records



R-4 RANGE ANALYSIS HANDBOOK

Exhibit 63

S A M P L E

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.

R-4 RANGE ANALYSIS HANDBOOK

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.)

R-4 RANGE ANALYSIS HANDBOOK

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 determinant 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 displacement 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

R-4 RANGE ANALYSIS HANDBOOK

- (25) Orr, Howard K.
1957. Effects of plowing and seeding on some forage production and hydrologic characteristics of subalpine range in central Utah. U.S. Forest Serv. Intermountain Forest and Range Expt. Sta., Res. Paper 47, 23 pp.
- (26) Packer, Paul E.
1951. Status of research on watershed protection requirements for granitic mountain soils in southwestern Idaho. U.S. Forest Serv. Intermountain Forest and Range Expt. Sta., Res. Paper 27, 20 pp.
- (27)
1953. Effects of trampling disturbance on watershed condition, runoff, and erosion. Jour. Forestry 51: 28-31.
- (28) Peele, T. C.
1955. Infiltration rates of soils as related to their inherent characteristics and to management practices. Plant Food Jour. 9: 10-11.
- (29) Raney, W. A., Edminster, T. W., and Allaway, W. H.
1955. Current status of research in soil compaction. Soil Sci. Soc. Amer. Proc. 19: 423-428.
- (30) Rauzi, Frank
1955. Water infiltration studies in the Big Horn National Forest. Mimeograph Cir. 58. Big Horn cooperative project.
- (31) Renner, F. G.
1936. Conditions influencing erosion on the Boise River watershed. U.S. Dept. Agr Tech. Bul. 528.
- (32) Robertson, Joseph H.
1933. Effect of frequent clipping on the development of certain grass seedlings. Plant Physiol. 8: 425-447.
- (33) Stoddart, L. A.
1946. Some physical and chemical responses of *Agropyron spicatum* to herbage removal at various seasons. Utah Agr. Expt. Sta. Bul. 324, 24 pp.
- (34) Tolstead, William L.
1942. Vegetation of the northern part of Cherry County, Nebraska. Ecol. Monog. 12: 255-292.
- (35) Voight, John W. and Weaver, J. E.
1951. Range condition classes of native midwestern pastures. An ecological analysis. Ecol. Monog. 21: 39-60.
- (36) Weaver, J. E., and Hansen, W. W.
1941. Native midwestern pastures — their origin, composition, and degeneration. Univ. Nebr. Conserv. and Survey Div. Bul. 22, 93 pp.
- (37) and Hougen, V. H.
1939. Effects of frequent clippings on plant production in prairie and pasture. Amer. Mid. Nat. 21: 396-414.
- (38) Jantti, A and Heinonen R.
1957. Effects of defoliation and soil moisture on grassland regrowth. Brit. Grassland Soc. Jour. 12: 56-61.

R-4 RANGE ANALYSIS HANDBOOK

- (10) Edmond, D. B.
1958. Animal treading and pastures. Agri. Rev. Land 1958 4, No. 2 (Grassland Div. D.S.I.R., N.Z.) Herbage Abs., 28: 1313.
- (11) Ellison, Lincoln
1954. Subalpine vegetation of the Wasatch Plateau, Utah. Ecol Monog. 24: 89-184.
- (12) Hanson, W. R. and Stoddart, L. A.
1940. Effects of grazing upon bunch wheatgrass. Jour. Amer. Soc. Agron. 32: 278-289.
- (13) Heady, Harold F.
1950. Studies on bluebunch wheatgrass in Montana and height-weight relationships of certain range grasses. Ecol. Monog. 20: 35-81.
- (14) Hormay, August L.
1956. Proper management of cattle ranges. Unpublished paper presented at the Forest Service Range Mangt. Conf. held at Ogden, Utah.
- (15) Huberty, M. R.
1944. Compaction in cultivated soils. Amer. Geophys. Union Trans. 25: 896-899.
- (16) Jardine, James T. and Anderson, Mark
1919. Range management on the national forests. U.S. Dept. Agr. Bul. 790, 98 pp.
- (17) Johnson, E. A.
1952. Effect of farm woodland grazing on watershed values in the southern Appalachian Mountains. Jour. Forestry 50: 109-113.
- (18) Johnson, W. M.
1953. Effects of grazing intensity upon vegetation and cattle gains on ponderosa pine-bunchgrass ranges of the Front Range of Colorado. U.S. Dept. of Agr. Cir. 929.
- (19) -----
1957. Forest Service research in Wyoming project summary. Range Mangt. files.
- (20) Lull, Howard W.
1959. Soil compaction on forest and rangelands. U.S. Dept. Agr. Misc. Pub. 768.
- (21) Marston, Richard B.
1952. Ground cover requirements for summer storm runoff control on aspen sites in northern Utah. Jour. Forestry 50: 303-307.
- (22) McIlvanie, Samuel K.
1942. Carbohydrate and nitrogen trends in bluebunch wheatgrass, *Agropyron spicatum*, with special reference to grazing influences. Plant Physiol. 17: 540-557.
- (23) O'Connor, K. F.
1957. Influence of treading on grasslands. Diss. Abs. 1957, 17, No. 1, 4-5. Cornell Univ. Ithaca, N. Y.
- (24) -----
1956. Influence of treading on grasslands. Pub. 19, 782. Cornell Univ., Ithaca, N. Y.

R-4 RANGE ANALYSIS HANDBOOK

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 soils 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."

61.6 Basic References.

- (1) Alderfer, R. B. and Merkle, F. G.
1941. Structural stability and permeability of mature forest soils compared with cultivated areas on same soil type. Soil Sci. Soc. Amer. Proc. 6: 98-103.
- (2) Beetle, A. A.
1956. Range survey in Wyoming's Big Horn Mountains. Wyoming Agr. Expt. Sta. Bul. 341.
- (3) Biswell, Harold H. and Weaver, J. E.
1933. Effect of frequent clipping on the development of roots and tops of grasses in prairie sod. Ecology 14: 368-390.
- (4) Blaisdell, James P. and Pechanec, Joseph F.
1949. Effects of herbage removal at various dates on vigor of bluebunch wheatgrass and arrowleaf balsamroot. Ecology 30: 298-305.
- (5) Branson, Farrel A.
1953. Two new factors affecting resistance of grasses to grazing. Jour. Range Mangt. 6: 165-171.
- (6) Carter, J. F. and Law, A. G.
1948. The effects of clipping on the vegetative development of some perennial grasses. Amer. Soc. Agron. Jour. 40: 1084-1091.
- (7) Craddock, G. W. and Pearse, C. K.
1938. Surface runoff and erosion on granitic mountain soils of Idaho as influenced by range cover, soil disturbance, slope and precipitation intensity. U.S. Dept. Agr. Cir. 482.
- (8) Crider, Franklin J.
1955. Root-growth stoppage resulting from defoliation of grass. U.S. Dept. Agr. Tech. Bul. 1102, 23 pp.
- (9) Dyksterhuis, E. J.
1949. Condition and management of rangeland based on quantitative ecology. Jour. Range Mangt. 2: 104-115.

R-4 RANGE ANALYSIS HANDBOOK

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

<i>Grazing Intensity</i>	<i>Granitic Soils</i>	<i>Sedimentary Soils</i>
Heavy	— 56%	— 73%
Moderate	— 54%	— 20%
Light	— 8%	— 20%

R-4 RANGE ANALYSIS HANDBOOK

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 has 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 ungrazed 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 varied 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

R-4 RANGE ANALYSIS HANDBOOK

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

R-4 RANGE ANALYSIS HANDBOOK

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 Heinonen (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 50 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 palatability 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-

R-4 RANGE ANALYSIS HANDBOOK

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.

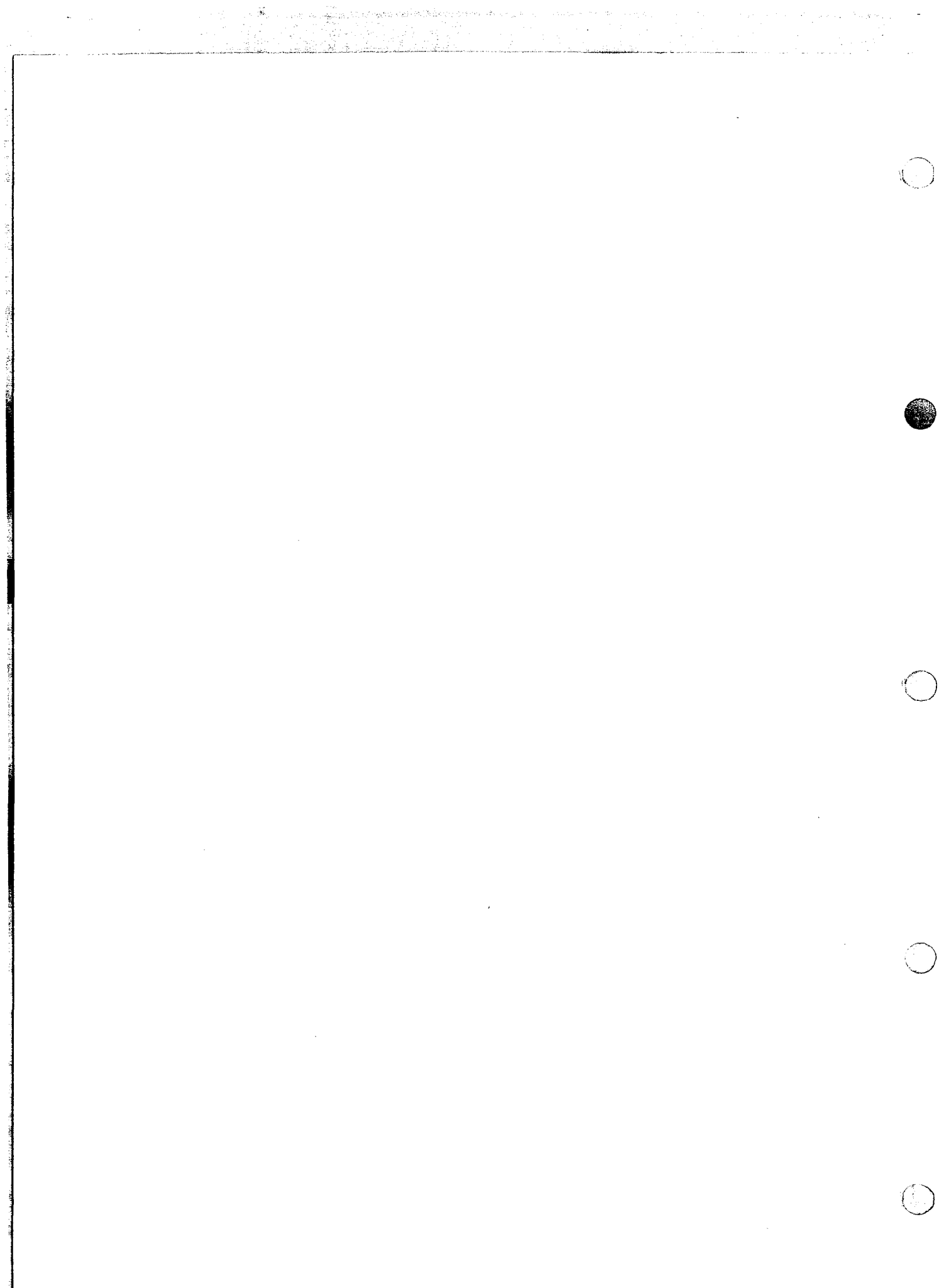
61 — BASIS FOR DETERMINING PROPER USE. The amount of grazing that a site in satisfactory condition can stand and maintain itself in such condition depends on a number of factors. The more important are slope, aspect, species composition, soil structure and type, season of use, and class of grazing animals. 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.



R-4 RANGE ANALYSIS HANDBOOK

CHAPTER 60

PROPER USE DETERMINATION

Contents

61	BASIS FOR DETERMINING PROPER USE
61.1	Effects of Herbage Removal on the Plants
61.2	Selective Grazing Habits of the Animals
61.3	Mechanical Effects of Grazing on the Plants and Soil
61.4	Vegetal Cover as a Factor in Site Stability and Its Relation to Grazing Use
61.5	Results of Grazing Trials on Mountain Rangelands
61.6	Basic References
62	FACTORS USED IN PROPER USE DETERMINATION
62.1	Trend in Condition
62.2	Forage Utilization
62.3	Forage Vigor
62.4	Soil Disturbance Due to Trampling
62.41	Soil Displacement
62.42	Soil Compaction
62.5	Ground Cover
62.51	General Ground Cover Requirements
62.52	Ground Cover Maintenance in Tall Forb Communities
63	PROPER USE CRITERIA



R-4 RANGE ANALYSIS HANDBOOK

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

55.1 — Kinds of Utilization Cages. Any enclosure 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.

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 sedgebrush 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%
RABBITRUSH & 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

$$\begin{aligned}
 \text{Grasses} &= 540^{\#} \times .50 = 270^{\#} \\
 \text{Forbs} &= 180^{\#} \times .25 = 45^{\#} \\
 \text{Shrubs} &= 20^{\#} \times .45 = 9^{\#} \\
 \text{Total} &= 324^{\#} \\
 &\quad \text{Air-dry} \\
 &\quad \text{forage} \\
 &\quad \text{Consumed}
 \end{aligned}$$

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

$$24^{\#} = \text{consumption / day}$$

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

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

ESTIMATED USE

CALCULATIONS

For cattle

$$\frac{14 \times 100}{12} = 11.7 \text{ cow days use per acre}$$

For deer

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

R-4 RANGE ANALYSIS HANDBOOK

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 righthand corner of the form. (See example, Exhibit 54.)

9 5
3 3
1 1
8

R-4 RANGE ANALYSIS HANDBOOK

53.1 — Determining Forage Production, Forage Utilization, and Percent Composition. See Chapter 40, Section 41.21.

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. See Chapter 40, Section 41.24.

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 41.21-B) 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:

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

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.

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

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

$$\text{Grasses} - 560^* \times .45 = 252^*$$

$$\text{Forbs} - 130^* \times .25 = 32^*$$

$$\text{Shrubs} - 10^* \times .60 = 6^*$$

$$\text{Total} = 290^* \text{ air dry forage consumed}$$

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

ESTIMATED USE

CALCULATIONS

For cattle

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

For deer

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

* 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.

R-4 RANGE ANALYSIS HANDBOOK

Exhibit 53

GRAZING IMPACT ANALYSIS

BENCHMARK NO. 3

Bannock Indian Head Meadow Valley John Jones 9/20/63
 FOREST RANGER DISTRICT ALLOTMENT EXAMINER - DATE

1 of 1 .96 2 chains 51 ⁴⁸/₁₀₀ ± Poor Cattle 5% SW
 TRANSECT PLOT PLOT IN- RANGE RANGE CLASS SLOPE-
 NUMBER SIZE* TERVAL TYPE CONDITION* OF USE ASPECT

1/4 mile West of the upper pond in the Meadow Valley Cr. drainage 7,800'
 LOCATION ELEVATION

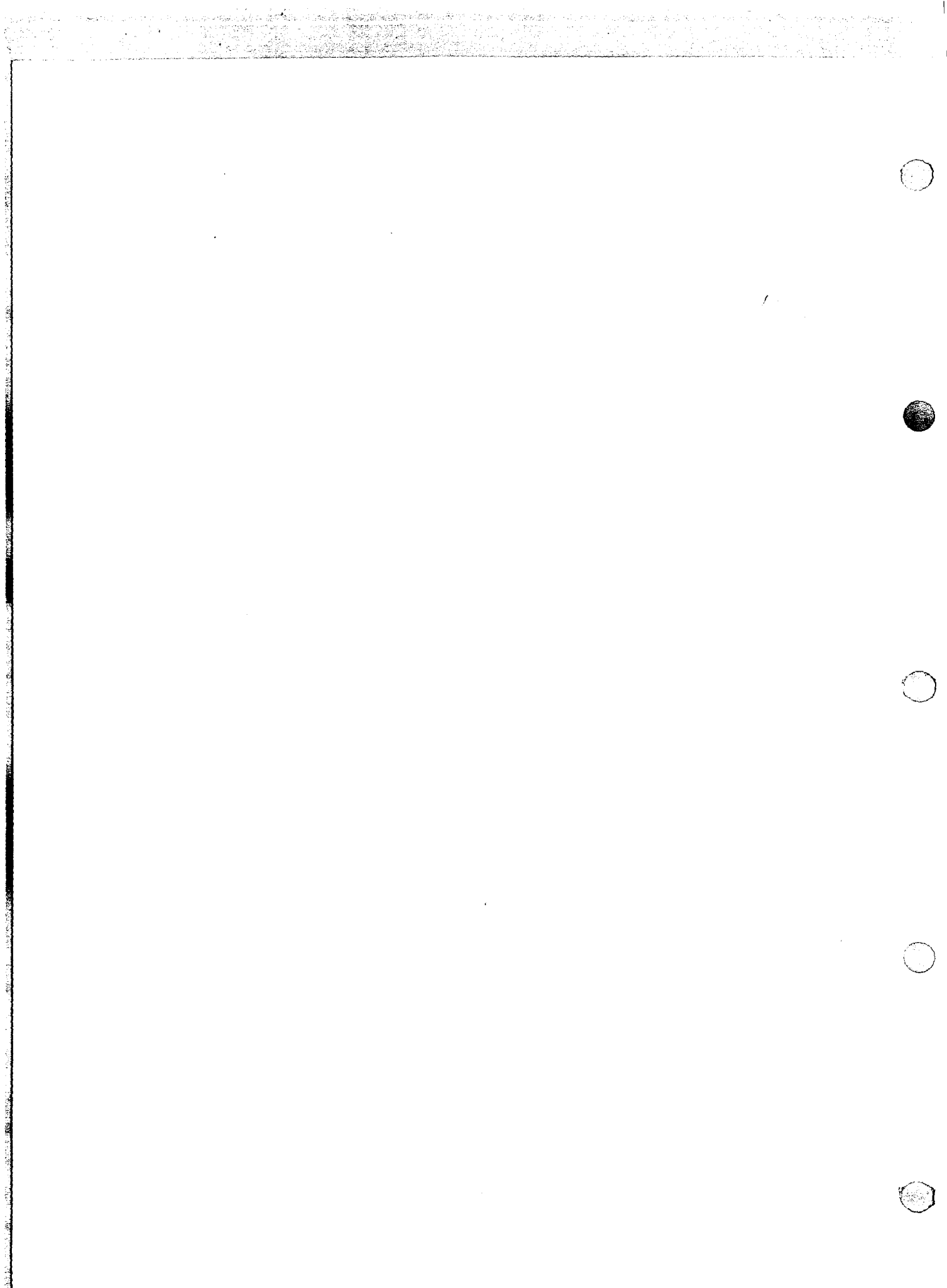
	SPECIES	PLOTS										TOTAL PROD.	GRAMS USED	% UTIL
		1	2	3	4	5	6	7	8	9	10			
GRASSES	<i>Stla</i>	10 ¹⁰	2 ¹⁰		T	3 ¹⁰			2 ¹⁰	7 ¹⁰	1 ¹⁰	50	25	50
	<i>Koe</i>		1	1	2	1 ¹⁰	5 ¹⁰			1 ¹⁰	4 ¹⁰	24	9	37
	<i>Agsm</i>	4 ¹⁰										5	1	20
	<i>Mumta</i>		3 ¹⁰	T		1	3 ¹⁰					12	5	42
	<i>Stca</i>		3 ¹⁰				6 ¹⁰					15	6	40
	<i>Cado</i>			1 ¹⁰				3				5	1	20
	<i>Frov</i>			1						2		3	0	0
	<i>Pafe</i>			2			1 ¹⁰	3 ¹⁰	3 ¹⁰	1 ¹⁰	2 ¹⁰	21	9	43
	Total-grasses											135	56	47
FORBS	<i>Triz</i>								5 ¹⁰		5 ¹⁰	1	7	7
	<i>LuKi</i>								1			1	0	0
	<i>Astz</i>	T				3						3	0	0
	<i>Eriz</i> ²		T	2		1			T			3	0	0
	<i>Astz</i> ²								1 ¹⁰			1	7	7
	<i>Agoz</i>								1 ¹⁰			2	1	50
	<i>Taof</i>	12 ¹⁰										24	12	50
	<i>Andi</i> ²	5	9	19		T	9		5			47	0	0
SHRUBS	Total-forbs											82	13	16
	<i>Chvi</i>									3 ¹⁰		4	1	25
	<i>Arca</i>					45		40	50			135	0	0
100%	Total-shrubs											139	1	1
100%	% OVERSTORY (SHRUB)					10		10	10	T		Totals	Averages	
	% CROWN COVER (HERB.)											30	3	
	% BARE GROUND	60	60	45	40	30	30	70	40	50	25	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 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.

FORM R4-2200-B (4/63)

(OVER)

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



R-4 RANGE ANALYSIS HANDBOOK

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.



R-4 RANGE ANALYSIS HANDBOOK

CHAPTER 50

GRAZING IMPACT ANALYSIS

Contents

51	SELECTING BENCH MARKS
51.1	Rules to be Followed in Selecting Bench Marks
52	LAYING OUT THE TRANSECT
53	RECORDING DATA ON GRAZING IMPACT ANALYSIS, FORM R4-2200-8
53.1	Determining Forage Production, Forage Utilization, and Percent Composition
53.2	Overstory Vegetal Cover
53.3	Ground Cover Determination
53.4	Soil Disturbance - Displacement and Compaction
53.5	Use Intensity Determination
53.6	Effect of Current Grazing on the Site
54	SUMMARY FOR GRAZING IMPACT ANALYSIS, FORM R4-2200-3
55	UTILIZATION CAGES
55.1	Kinds of Utilization Cages
55.2	Use of Utilization Cages

R-4 RANGE ANALYSIS HANDBOOK

SOIL: SURFACE TEXTURE loam; THICKNESS 12"; pH 6.0
 SUBSOIL TEXTURE Gr. Clay loam; THICKNESS 24"; pH 6.5
 SUBSTRATUM MATERIAL Fractured sandstone; EFFECTIVE ROOTING DEPTH 36"
 REMARKS _____

EROSION PATTERN: SURFACE LOSSES AVERAGE — INCHES OVER — % OF THE AREA
 GULLIES TOTAL APPROXIMATELY — FEET IN LENGTH AND AVERAGE ABOUT — FEET DEEP
 REMARKS No apparent erosion on the site

INHERENT EROSION HAZARD: DETACHABILITY RATING 6; SURFACE COVERED WITH ROCK FRAGMENTS $\frac{1}{2}$ INCH OR GREATER
 IN DIAMETER 5 %; ADJUSTED DETACHABILITY RATING 6
 PROFILE PERMEABILITY RATING 7; SOIL ERODIBILITY INDEX 42; CLASS II
 SLOPE 15 %; INHERENT EROSION HAZARD, CLASS II

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

COVER DISPERSION: UNIFORM ☒ FAIRLY UNIFORM ☐ VARIABLE ☐ HIGHLY VARIABLE ☐

ESTIMATED POTENTIAL PRODUCTION FOR SITE 1650 LBS. PER ACRE (DRY WT.)

GIVE REASONS FOR SUITABILITY CLASSIFICATION Gently rolling topography; within $\frac{1}{2}$ mile of permanent water; soil well stabilized by vegetation and litter.

ESTIMATED USE BASED ON UTILIZATION

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%

CALCULATIONS

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

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

R-4 RANGE ANALYSIS HANDBOOK

Exhibit 42.1
OCULAR ANALYSIS

WRITEUP NO. 53						PHOTO NO. CVD-15K-50	
FOREST Bannock		RANGER DISTRICT strawberry		ALLOTMENT Lake Park		EXAMINER Wm. Smith	
DATE 6/24/62							
TRANSECT NO. —	PLOT SIZE —	PLOT INTERVAL —	TYPE DESIGNATION S18L-2	KIND OF L. STOCK Cattle	SLOPE 15%	ASPECT SW	
LOCATION In Pilot PK. basin						ELEVATION 8,000	

	DESIRABLE	PERCENT COMPOS.	INTERMEDIATE	PERCENT COMPOS.	LEAST DESIRABLE	PERCENT COMPOS.
GRASSES	Elai	19	Pose	1		
	Maby	4				
	Faid	2				
	Stca 2	2				
	Brma	3				
	Pma	1				
	Agsp	2				
FORBS	Lupz	5	Agz	7	Annz	7
	Basa	4	Eriz	7	Wvam	2
	Lupz	5	Wvam	5	Tarf	7
	Crez	1	Thfo	5		
	Agur	3	Gerz	3		
	Hofl	5	Astz	4		
	Houn	6	Vioz	1		
SHRUBS			Daiz	1		
	Symz	3	Artr	8		
			Chvi	5		
TOTALS		65		33		2

% OVERSTORY (TREES) _____
 % OVERSTORY (SHRUB) 5
 % CROWN COVER (HERBACEOUS) _____
 % BARE GROUND 5
 % ROCK AND PAVEMENT (NATURAL) 5
 % ROCK AND PAVEMENT (UNNATURAL) 0
 % VEGETATION AND LITTER 90 } 100%
 COWCHIPS PER ACRE 150 (last year's)
 COW DAYS PER ACRE 12.5
 PELLET GROUPS PER ACRE S 0 D 0 E 0 M _____
 SHEEP DAYS PER ACRE _____
 GAME DAYS PER ACRE D 2 E 0 M _____
 ESTIMATED TOTAL FORAGE PRODUCTION - LBS PER ACRE (DRY WT.) 1600
 ESTIMATED TOTAL PRODUCTION - D AND I PLANTS - LBS. PER ACRE (DRY WT.) 1568
 ESTIMATED POTENTIAL PRODUCTION - LBS PER ACRE (DRY WT.) 1650

CONDITION RATING:

COMPOSITION RATING 43
 PRODUCTION RATING 38
 FORAGE CONDITION RATING 81
 GROUND COVER INDEX 40
 CURRENT EROSION INDEX 45
 SOIL CONDITION RATING 85
 FORAGE UTIL. - LIGHT ☒ MOD. _____ HEAVY _____
 BROWSE: COND. Fair APPARENT TREND →
 PERCENT SOIL DISTURBANCE: _____
 GRAZING ANIMALS 0
 RODENTS 1

* ON BASIS OF DRY WEIGHT ESTIMATES.

R-4 RANGE ANALYSIS HANDBOOK

8. *Soil and Erosion Data.* (See Section 41.26.) Place information on the back of form R4-2200-10.
9. *Cover Dispersion.* (See Section 41.27.) Cover dispersion will be estimated using as a guide the determination made with the weight estimate site analysis.
10. *Condition Rating.* (See Section 41.28-1.)
11. *Forage Utilization.* Classify forage utilization as light, moderate, or heavy. Clipping and weighing selected plants periodically should be done to temper judgment.
12. *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. (See Section 41.28-2 and Chapter 90, Section 93.3.)
13. *Soil Disturbance.* Estimate soil disturbance. (See Section 41.24.) The findings of the weight estimate analyses should be used for guidance in this operation.
14. *Estimated Potential Production.* (See Section 41.28-4.)

R-4 RANGE ANALYSIS HANDBOOK

42 — OCULAR ANALYSIS.

With the exception of types 7 and 8 an ocular site analysis will be made in each classification not covered by a weight estimate site analysis. Sufficient time must be spent in each situation or site to complete form R4-2200-10. The examiner should walk through the area listing species and assigning each a composition rating. "Chip" and "pellet" group counts will be made along a strip transect as the area is being inspected. The examiner should stop periodically and make observations of ground cover, soil stability, and other items called for on the form. Guidance for classifying the various soil characteristics will come from the more intensive weight estimate transects. Wherever a new situation is encountered such as an abrupt change in vegetal type, condition, or suitability, the observer will train his judgment by running a weight estimate site analysis.

42.1 — Steps to Take in Running an Ocular Analysis.

1. *List Species.* Species within the area being analyzed will be listed on form R4-2200-10 as "Desirables," "Intermediates," and "Least Desirables." The grasses, forbs, and shrubs should be grouped as indicated in each column. Plant species which are rated under more than one classification will be listed in more than one column. (See Exhibit 42.1.)

2. *Percent Composition.* An estimate on a dry weight basis will be made of the percent each plant species makes of the total plant composition. If a plant makes up a portion of the composition in excess of that assigned the plant under the species list, the excess will be assigned to the next classification. For example, if a plant makes up 30 percent of the vegetal cover and the species list allows this plant to make up 10 percent of the composition as a "Desirable" and over 10 percent as "Intermediates" then 10 percent will be assigned to the species in the "Desirable" column and 20 percent in the "Least Desirable" column.

3. *Desirables, Intermediates and Least Desirables.* Each of the columns "Desirables," "Intermediates," and "Least Desirables" will be totaled. The summation of all three columns must equal 100.

4. *Overstory Vegetal Cover.* (See Section 41.22.)

5. *Ground Cover Determination.* (See Section 41.23.) Estimate percent bare ground, percent rocks and pavement — natural, percent rocks and pavement — unnatural, and percent vegetation and litter.

6. *Use Intensity Determination.* (See Section 41.25.) Pellet group and chip counts will be made on 1/100 acre plots. Plots one chain long and 6.6 feet wide can be used as the observer moves from one observation point to another. Pellet groups will be shown as sheep (S), deer (D), elk (E), or moose (M).

7. *Forage Production.* Total herbage production will be estimated on a dry weight basis followed by a calculation of forage production based only upon Desirable and Intermediate plants. This is accomplished by adding the percentage of Desirable and Intermediate plants and multiplying this sum by total production. Production estimates are checked by periodic clippings and weighings.

R-4 RANGE ANALYSIS HANDBOOK

SOIL: SURFACE TEXTURE Gr. Sandy loam; THICKNESS 20"; pH 6.5
 SUBSOIL TEXTURE Gr. Heavy sandy loam; THICKNESS 28"; pH 6.3
 SUBSTRATUM MATERIAL Highly weathered granite; EFFECTIVE ROOTING DEPTH 48"
 REMARKS _____

EROSION PATTERN: SURFACE LOSSES AVERAGE 1 INCHES OVER 2 % OF THE AREA
 GULLIES TOTAL APPROXIMATELY 0 FEET IN LENGTH AND AVERAGE ABOUT _____ FEET DEEP
 REMARKS Only an occasional bare spot in this type

INHERENT EROSION HAZARD: DETACHABILITY RATING 9; SURFACE COVERED WITH ROCK FRAGMENTS $\frac{1}{8}$ INCH OR GREATER
 IN DIAMETER 7 %; 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 Light (NONE, LIGHT, MODERATE, HEAVY)

COVER DISPERSION: UNIFORM _____ FAIRLY UNIFORM V VARIABLE _____ HIGHLY VARIABLE _____

ESTIMATED POTENTIAL PRODUCTION FOR SITE 1175 LBS. PER ACRE (DRY WT.)

GIVE REASONS FOR SUITABILITY CLASSIFICATION This area is 2 miles from water and on a moderately steep slope. Use is made of the site only after excessive use is made of the suitable range.

ESTIMATED USE BASED ON UTILIZATION

CONVERSION FACTORS:

CALCULATIONS

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%

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

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

R-4 RANGE ANALYSIS HANDBOOK

Exhibit 41.3

SITE ANALYSIS SUMMARY

WRITEUP NO. <i>A10</i>						PHOTO NO. <i>24-171</i>	
FOREST <i>Palisade</i>		RANGER DISTRICT <i>White River</i>		ALLOTMENT <i>Bald Mountain</i>		EXAMINER <i>John Anderson</i>	
TRANSECT NO. <i>—</i>		PLOT SIZE <i>96</i>		PLOT INTERVAL <i>1 ch.</i>		DATE <i>6/23/63</i>	
		TYPE DESIGNATION <i>U4 22-2</i>		KIND OF LIVESTOCK <i>Cattle</i>		SLOPE <i>35%</i>	
LOCATION <i>On the south side of Willow Creek near the forks</i>						ASPECT <i>NE</i>	
						ELEVATION <i>7,500</i>	

SPECIES	TOTAL PRODUCTION - GREEN WEIGHT				DRY WT.	* PROD. DRY WT. PER ACRE	PERCENT COMPOSITION	DESIRABILITY RATING
	TRANS 1	TRANS 2	TRANS 3	TOTAL				
<i>Foid</i>	<i>51</i>	<i>90</i>	<i>75</i>	<i>216</i>	<i>119</i>	<i>397</i>	<i>38</i>	<i>30.8</i>
<i>Agsp</i>	<i>50</i>	<i>61</i>	<i>51</i>	<i>162</i>	<i>81</i>	<i>270</i>	<i>25</i>	<i>25</i>
<i>Hebu</i>	<i>7</i>	<i>9</i>	<i>15</i>	<i>36</i>	<i>18</i>	<i>60</i>	<i>6</i>	<i>51</i>
<i>stro²</i>	<i>7</i>			<i>7</i>	<i>4</i>	<i>13</i>	<i>1</i>	<i>1</i>
<i>Elei</i>	<i>2</i>			<i>2</i>	<i>1</i>	<i>3</i>	<i>7</i>	
<i>Pose</i>	<i>11</i>	<i>9</i>	<i>6</i>	<i>26</i>	<i>16</i>	<i>53</i>	<i>5</i>	<i>5</i>
<i>Total grasses</i>						<i>796</i>	<i>75</i>	
<i>Eriz</i>	<i>51</i>	<i>15</i>	<i>11</i>	<i>77</i>	<i>27</i>	<i>90</i>	<i>8</i>	<i>8</i>
<i>Vio2</i>	<i>1</i>	<i>2</i>		<i>3</i>	<i>1</i>	<i>3</i>	<i>7</i>	
<i>Ann2</i>	<i>1</i>	<i>1</i>	<i>7</i>	<i>2</i>	<i>1</i>	<i>3</i>	<i>7</i>	
<i>Lup2</i>	<i>64</i>	<i>66</i>	<i>7</i>	<i>130</i>	<i>32</i>	<i>11</i>	<i>1</i>	<i>1</i>
<i>Ag22</i>	<i>2</i>	<i>7</i>		<i>2</i>	<i>1</i>	<i>3</i>	<i>7</i>	
<i>Total forbs</i>						<i>110</i>	<i>9</i>	
<i>Artr</i>	<i>34</i>	<i>3</i>	<i>45</i>	<i>82</i>	<i>41</i>	<i>137</i>	<i>13</i>	<i>11.3</i>
<i>Chvi</i>	<i>5</i>	<i>4</i>	<i>10</i>	<i>19</i>	<i>9</i>	<i>30</i>	<i>3</i>	<i>3</i>
<i>Total browse</i>						<i>167</i>	<i>16</i>	
<i>TOTAL</i>					<i>AVERAGE</i>	<i>AV. 1073</i>	<i>X X X</i>	<i>62353</i>
% OVERSTORY (TREES)						% DESIRABLE		<i>62</i>
% OVERSTORY (SHRUBS)	<i>5</i>	<i>1</i>	<i>22</i>	<i>28</i>	<i>9</i>	% INTERMEDIATE		<i>35</i>
% CROWN COVER (HERB.)						% LEAST DESIRABLE		<i>3</i>
% BARE GROUND	<i>13</i>	<i>20</i>	<i>16</i>	<i>49</i>	<i>16</i>	CONDITION RATING:		
% ROCK & PAV. (NAT.)		<i>7</i>	<i>4</i>	<i>11</i>	<i>4</i>	COMPOSITION RATING		<i>41</i>
% ROCK & PAV. (UNNAT.)	<i>11</i>			<i>11</i>	<i>4</i>	PRODUCTION RATING		<i>36</i>
% VEG. & LITTER	<i>76</i>	<i>73</i>	<i>80</i>	<i>229</i>	<i>76</i>	FORAGE CONDITION RATING		<i>77</i>
% SOIL DISTURBANCE						GROUND COVER INDEX		<i>37</i>
AV. NO. DROPPINGS						CURRENT EROSION INDEX		<i>40</i>
AV. NO. PELLET GROUPS						SOIL CONDITION RATING		<i>73</i>

* CALCULATE BY FORMULA BASED ON SIZE OF PLOTS USED (SEE 41.3-3)

R4-2200-14 (5/64)

BROWSE: CONDITION *Good* APPARENT TREND *→*

R-4 RANGE ANALYSIS HANDBOOK

41.3 - Site Analysis Transect Summary. Where more than one transect is run on a site, the information will be summarized on form R4-2200-14. (See Exhibit 41.3.)

1. *Transferring Data from the Site Analysis Forms.* Data from the total production column 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 fourth column under the main heading "Total Production, Green Weight."

2. *Conversion to Dry Weight.* Convert the total green weight column to dry weight. (See Exhibit 41.21-B.)

3. *Dry Weight Production Per Acre.* Conversion to dry weight production per acre requires different formulas for the different plot sizes used. Following are the conversion formulas for each of the four plot sizes listed in Section 41.1-5.

Plot Size

.96 sq. ft. =	$\frac{\text{Total dry wt.} \times 10}{\text{Number of transects}}$	= Pound production per acre
1.92 sq. ft. =	$\frac{\text{Total dry wt.} \times 5}{\text{Number of transects}}$	= Pound production per acre
4.8 sq. ft. =	$\frac{\text{Total dry wt.} \times 2}{\text{Number of transects}}$	= Pound production per acre
9.6 sq. ft. =	$\frac{\text{Total dry wt.}}{\text{Number of transects}}$	= Pound production per acre

4. *Completion of Summary Form.* The rest of computation will follow the same procedure described for form R4-2200-13. (See Section 41.28-1 to 4.) 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.

R-4 RANGE ANALYSIS HANDBOOK

Exhibit 41.28-D

APPARENT TREND

VEGETATION

Up or Stable

1. Desirable frequency groupings and age classes of desirables, intermediates and least desirables.
2. Forage plants not being pulled up or trampled out by grazing.
3. Vigor of key species high as indicated by leaf length, seed stock production and normal color.
4. Browse species showing no hedging.

Down

1. A disproportionate amount of intermediates and least desirables. Seedlings of better plants having difficulty in becoming established.
2. Forage species being pulled up and trampled out by grazing.
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 moderate to heavy hedging.

SOIL

Up or Stable

1. Ground cover dispersion — uniform.
2. No detectable soil movement.
3. Soil surface continuous and intact.
4. No exposure of plant roots.
5. Stones and rock fragments, where present, normal and in place — no movement of rock fragments.
6. Lichen lines on stones and rock fragments extend to soil level.
7. No active gullies.
8. No recent soil deposits either alluvial or aeolian.
9. No wind-scoured depressions.

Down

1. Ground cover dispersion — variable to highly variable.
2. Soil movement detectable.
3. Cupping out between soil remnants.
4. Plant roots exposed.
5. Stones and rock fragments, where present, concentrating on surface as erosion pavement. Fragments loose and often moving downslope.
6. Lichen lines on stones considerably above soil surface — no lichens on rock fragments.
7. Active gullies — indicated by recent cutting and sloughing.
8. Recent soil deposits — alluvial or aeolian.
9. Wind-scoured depressions.

R4-2200-25 (7/64)

R-4 RANGE ANALYSIS HANDBOOK

4. *Soil movement heavy:* 11-20

Heavy erosion is characterized by numerous and continuous sod 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.

R-4 RANGE ANALYSIS HANDBOOK

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.

R-4 RANGE ANALYSIS HANDBOOK

Exhibit 41.28-C

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

Ground Cover Index

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

*If the dispersion rating for a site is below that shown in any one of the above classifications, the ground cover index will be dropped five (5) points for each dispersion rating below the one indicated.

Cover Dispersion Guide

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

R-4 RANGE ANALYSIS HANDBOOK

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.

R-4 RANGE ANALYSIS HANDBOOK

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

Current Soil Erosion

- | | <i>Points</i> |
|---|---------------|
| 1. <i>No evidence of soil movement:</i> | 41-50 |
| <p>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.</p> | |
| 2. <i>Soil movement slight and local:</i> | 31-40 |
| <p>Isolated bare soil openings characterize this stage. Erosion is confined more or less to the individual bare soil opening. Indicators may include:</p> <ul style="list-style-type: none"> a. Wind scouring when soil is dry (particularly after trampling by live-stock). b. Rills are lacking except in the larger interspaces after heavy storm. c. Some erosion pavement may occur in interspaces on gravelly soils. | |
| 3. <i>Soil movement moderate:</i> | 21-30 |
| <p>Bare soil openings larger and frequently joined together. Earmarks of active erosion may include one or more of the following indicators:</p> <ul style="list-style-type: none"> 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. | |

R-4 RANGE ANALYSIS HANDBOOK

Exhibit 41.28-B

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

Ground Cover Index

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

*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 Guide

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

***-GRAPHIC GUIDE FOR RATING VEGETAL CONDITION**

Production Chart

% of site potential DEI plants	Pro- duction 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.

[illegible]

R-4 RANGE ANALYSIS HANDBOOK

Exhibit 41.28-A

GUIDE FOR RATING VEGETAL CONDITION

A. Composition	Points
1. <i>Desirable Species Dominant</i>	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. <i>Desirable and Intermediate Species Mixed</i>	37-48
-Desirables and intermediates make up most of the stand but with the desirables maintaining the greater percentage. Least desirables unimportant.	
3. <i>Intermediate Species Dominant</i>	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. <i>*-Intermediate and/or Least Desirable Generally Dominant</i>	VC-BD
Desirable species make up a minority of the stand. One or two intermediates or least desirable species dominant.*	
5. <i>Least Desirable Species Dominant</i>	0-12
-Intermediates may be important in some stands. Desirables are generally unimportant. One or two least desirable species are generally dominant.	
B. <i>Production (as indicator of vigor and vegetal cover)</i>	
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

R-4 RANGE ANALYSIS HANDBOOK

(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 Exhibit 41.28-A.)

(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 Exhibit 41.28-A.)

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 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 5 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 41.28-B or 41.28-C.)

(2) *Current Erosion Index.* Classify current erosion index on the basis of Part II of the appropriate "Guide for Rating Soil Condition" (current soil erosion). (See Exhibits 41.28-B or 41.28-C.)

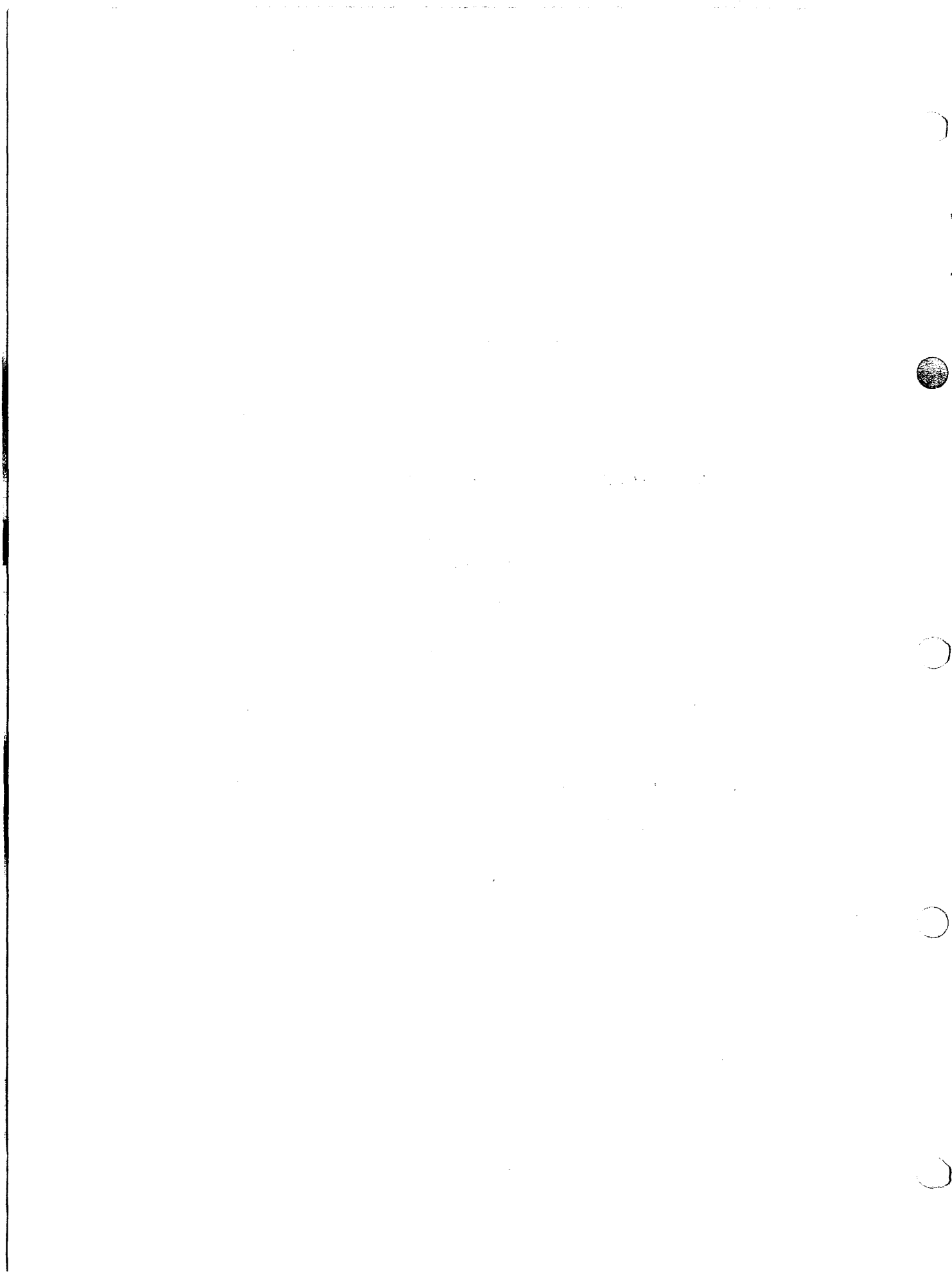
2. *Classification of Browse.* As a means of correlating livestock and game range analysis, the important browse species from the game management standpoint will be classified as to condition and apparent trend. This determination is in addition to the range analysis condition classification. For details of browse classification, see Chapter 90, Section 93.3.

3. *Apparent Trend.* Apparent trend in soil stability and vegetation will be determined separately for each classified area of suitable range and unsuitable but used land. 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:

$$S1 \begin{array}{c} 65 \rightarrow \\ \hline 45 \downarrow \end{array} = \begin{array}{l} \text{Suitable grassland range in good vegetal condition} \\ \text{with no apparent trend. Soil stability fair with a} \\ \text{downward trend.} \end{array}$$

Trend will be determined from trend transects when they are available. Apparent trend will be judged using the "Apparent Trend Guides." (See Exhibit 41.28-D and the discussion in Chapter 30 for further information.)

4. *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 seedlings. (See Exhibit 41.28-A and the appropriate condition standard in Chapter 30.)



Fuller(2)

FOREST SERVICE HANDBOOK

Ogden, Utah

June 1965

FSH 2212.01 — R-4 RANGE ANALYSIS HANDBOOK

AMENDMENT NO. 1

Superseded Pages

41.28-2

None

New Pages

41.28-2

41.28-2BA

DIGEST: To incorporate graphic guides for rating range vegetal condition into the Handbook. The graphic guide will simplify and increase the uniformity of condition classification.

FLOYD IVERSON
Regional Forester

R-4 RANGE ANALYSIS HANDBOOK

III. SOLUTION

1. Reduce the detachability index by the percentage of coarse fragments ($> \frac{3}{4}$ 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.

41.27 – 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 rating rather than the second lowest and second highest plots.

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, each receiving a maximum of 50 points, will be added to give the vegetation condition rating.

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"
Rapid (sands, loamy sands)	Little or No Reduction ¹	PROFILE PERMEABILITY INDEXES			
	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	6 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 9	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	9 or 10	9 or 10	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

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

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

³Commonly 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.

R-4 RANGE ANALYSIS HANDBOOK

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

R-4 RANGE ANALYSIS HANDBOOK

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 ($> \frac{3}{4}$ 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 to estimating permeability in the field.

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

R-4 RANGE ANALYSIS HANDBOOK

Exhibit 41.26-C

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.

R-4 RANGE ANALYSIS HANDBOOK

Exhibit 41.26-B

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.

R-4 RANGE ANALYSIS HANDBOOK

Exhibit 41.26-A

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.

R-4 RANGE ANALYSIS HANDBOOK

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. *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 alluvium, acid volcanic, etc. (See Exhibit 41.26-B for a list of common rocks.)

e. *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 demarcation 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 contents to relatively high stone contents, 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 gullyng is recorded. Additional information about the erosion patterns, trends in stability, or significance of wind erosion, etc., 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.* For information needed to make the soil erodibility appraisals see Exhibit 41.26-C. 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

R-4 RANGE ANALYSIS HANDBOOK

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.

41.25 – Use Intensity Determinations. Use intensity will be based upon either dropping and pellet group counts or upon the degree of utilization.

Dropping and pellet group information can be obtained by using the following types of plots.

1. *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.

2. *Strip Plots.* Strips 6.6 feet wide and one chain long make a 1/100-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 41.2.)

41.26 – 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 it is an index to the productive potential of the site. This data is placed on the back of form R4-2200-13. (See example, Exhibit 41.2.)

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

a. *Textural Classes.* Sand, sandy loam, loam, silt loam, clay loam, and clay will be used. Add the prefix "gravelly" or "stony" where these rock fragments occupy 15 percent or more of the soil volume; very gravelly (v. gr.) or very stony (v. st.) will be used where they occupy 50 percent or more of the volume. 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. (See Exhibit 41.26-A.)

R-4 RANGE ANALYSIS HANDBOOK

41.22 – Overstory Vegetal Cover.

1. *Tree Overstory.* On each plot estimate the percent overstory of trees.
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 – Ground Cover Determination. Percentage of bare ground, rock, pavement, 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.

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 under $\frac{1}{8}$ inch in diameter will be classed as soil, except in granite soils where $\frac{1}{4}$ inch will be the dividing point.

2. *Rock and Pavement.* Rock and pavement will be classed as either natural or unnatural.

- a. *Natural.* Undisturbed rock and pavement, which is not the result of accelerated erosion, will be considered a part of the natural ground cover. Natural rock and pavement can be identified by the presence of lichens on the rock surface and by the natural embedding of rocks in the soil.

- b. *Unnatural.* Loose rock and pavement that have been exposed or moved as a result of erosion will not be considered as ground cover. The absence of lichens on the rock or pavement is strong evidence of moving soil and rock and indicators of unnatural rock and pavement.

3. *Vegetation and Litter.*

- a. *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.

- b. *Litter.* All litter will be classed as ground cover, but will be considered as 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.

41.24 – 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.

R-4 RANGE ANALYSIS HANDBOOK

Symbol		Desirable	Intermediate	Least Desirable
FORBS				
Papu	Paronychia pulvinata (Pulvinate and Cadr. comm.)	x		
	P. pulvinata (Grass-sedge comm.)			x
Pegr	Pedicularis groenlandica	x		
Pepa ³	P. paysoniana		x	
Plaz	Plantago spp.			x
Poea	Podistera eastwoodae	x		
Polz ²	Polemonium spp.		x	
Pobi	Polygonum bistortoides	0-5	5-15	15+
Povi ²	P. viviparum		x	
Potz	Potentilla spp. (General)		x	
	P. spp. (Meadow)		0-10	10+
Pthe	Pteryxia hendersoni	x		
Ranz	Ranunculus spp.		x	
Sarh	Saxifraga rhomboidea		x	
Serh	Sedum rhodanthum		x	
Sest	S. stenopetalum			x
Sede	Selaginella densa (General)	x		
	S. densa (Meadow)		x	
	S. densa (Sedge-grass comm.)		x	
Secr	Senecio crassulus			x
Senz	S. spp. (General)		0-10	10+
	S. spp. (Meadow)			x
Sipr	Sibbaldia procumbens		x	
Siac	Silene acaulis (Pulvinate and Cadr. comm.)	x		
	S. acaulis (Other comm.)		x	
Smca	Smelowskia calycina		x	
Solz	Solidago spp.		x	
Taof	Taraxacum lyratum			x
Taly	T. officinale			x
Triz	Trifolium spp. (General)	0-10	10+	
	T. spp. (Meadow)		x	
	T. spp. (Cushion plant comm.)	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+	
Salz	Salix spp.	0-30	31-50	50+
Vagl	Vaccinium globulare	0-30	30+	
Vaca	V. caespitosum		x	

R-4 RANGE ANALYSIS HANDBOOK

Symbol		Desirable	Intermediate	Least Desirable
FORBS				
Acla	Achillea lanulosa (General)		0-5	5+
	A. lanulosa (Meadow)			x
Agoz	Agoseris spp.			x
Anse	Androsace septentrionalis (General)			x
	A. septentrionalis (Early succession)		x	
Annz	Annuals			x
Antz	Antennaria spp.		0-5	5+
Arez	Arenaria spp. (General)		x	
	A. spp. (Pulvinate community)	x		
Arnz	Arnica spp.		x	
Arno	Artemisia norvegica	x		
Arsc	A. scopulorum	x		
Astz ²	Aster spp. (General)		x	
	A. spp. (Meadow)			x
Cale	Caltha leptosepala	0-10	10+	
Caum	Campanula uniflora		x	
Casz	Castilleja spp.	x		
Eriz ²	Erigeron spp. (General)		x	
	E. spp. (Meadow)			x
Erel ³	Eritrichium elongatum (General)		x	
	E. elongatum (Early succession)	x		
Genz	Gentiana spp.	x		
Gero	Geum rossii (Gero comm.)	0-50	50+	
	G. rossii (Forb-grass comm.)	0-25	26-60	60+
	G. rossii (Kobe and grass-sedge comm.)	0-15	16-40	40+
	G. rossii (Meadow comm.)		0-20	20+
	G. rossii (Other comm.)		x	
Hyac	Hymenoxys acaulis		x	
Hygr	H. grandiflora		x	
Hymz	H. spp.			x
Ivgo	Ivesia gordonii		0-10	10+
Lepy	Lewisia pygmaea		x	
Llse	Lloydia serotina	x		
Lycz	Lychnis spp.		x	
Meci	Mertensia ciliata	x		

R-4 RANGE ANALYSIS HANDBOOK

Exhibit 41.21-D
SPECIES LIST
Alpine

Symbol		Desirable	Intermediate	Least Desirable
GRASSES and GRASSLIKE PLANTS				
Agsc	Agropyron scribneri	0-5	5+	
Agtr	A. trachycaulum	x		
Agsc ³	Agrostis scabra		x	
Agva	A. variabilis	x		
Aloz	Alopecurus spp.	x		
Capu	Calamagrostis purpurascens	x		
Cadr	Carex drummondiana (General)	0-25	25+	
	C. drummondiana (Grass-sedge comm.)	0-10	10+	
Caph	C. phaeocephala		x	
Caps	C. pseudoscirpoidea	0-15	15+	
Cato	C. tolmiei	0-15	15+	
Carz	C. spp. (Other)	x		
Dain	Danthonia intermedia	x		
Deca	Deschampsia caespitosa	x		
Elez	Eleocharis spp.		x	
Erch ²	Eriophorum chamissonis	x		
Feovb	Festuca ovina brachyphylla	x		
Hemo	Helictotrichon mortonianum	x		
Judr	Juncus drummondii		0-15	15+
Jupa	J. parryi		0-15	15+
Junz	J. spp. (Other)	x		
Kobe	Kobresia bellardii	x		
Lupi	Luzula piperi	x		
Lusp	L. spicata	x		
Phal	Phleum alpinum	x		
Poal	Poa alpina	0-5	5+	
Pose	P. secunda		x	
Poaz	P. spp. (Others)	x		
Trsp	Trisetum spicatum	x		

R-4 RANGE ANALYSIS HANDBOOK

Symbol		Desirable	Intermediate	Least Desirable
SHRUBS				
Opuz	Opuntia spp.		0-10	10+
Pamy	Pachistima myrsinites	0-10	11-25	25+
Penz	Penstemon spp.		x	
Pepr	P. fruticosa	0-10	10+	
Pera	Peraphyllum ramosissimum	0-10	11-25	25+
Phle	Philadelphus lewisii	x		
Phem	Phyllodoce empetrifomis	x		
Phma	Physocarpus malvaceus		0-30	30+
Popz	Populus spp.	0-10	10+	
Potr	P. tremuloides	0-10	10+	
Pofr	Potentilla fruticosa		0-10	10+
Prgl	Prosopis glandulosa		0-10	10+
Prem	Prunus emarginata	0-10	11-20	20+
Prfa	P. fasciculata	x		
Prvi	P. virginiana	0-10	11-20	20+
Psfo	Psoralea formosa		x	
Putr	Purshia tridentata	x		
Quga	Quercus gambelii	0-10	11-20	20+
Qutu	Q. turbinella	0-10	11-20	20+
Rhal	Rhamnus alnifolis		x	
Rhbe	R. betulaeifolia		x	
Rhpu	R. purshiana		x	
Rhgl	Rhus glabra		x	
Rhtr	R. trilobata		0-10	10+
Ribz	Ribes spp.		x	
Riin	R. inebrians		x	
Rimo	R. montigenum	0-10	10+	
Rosz	Rosa spp.		x	
Salz	Salix spp.	0-10	11-40	40+
Saca	Salvia carnososa		x	
Sagl	Sambucus glauca	x		
Sara	S. racemosa	0-10	11-25	25+
Save	Sarcobatus vermiculatus		0-20	20+
Sosc	Sorbus scopulina		x	
Spiz	Spirea spp.		x	
Symz	Symphoricarpos spp.	0-10	11-25	25+
Teca	Tetradymia canescens		x	
Vacz	Vaccinium spp.	x		
Vaca	V. caespitosum	0-5	5+	

R-4 RANGE ANALYSIS HANDBOOK

Symbol		Desirable	Intermediate	Least Desirable
SHRUBS				
Cesa	C. sanguineus	x		
Ceve	C. velutinus	0-10	11-25	25+
Ceoc	Cercis occidentalis		x	
Ceor	C. orbiculata		x	
Cein	Cercocarpus intricatus	x		
Cele	C. ledifolius	0-10	10+	
Cemo	C. montanus	0-10	10+	
Chmi	Chamaebatiaria millefolium		x	
Chli	Chilopsis linearis		x	
Chum	Chimaphila umbellata		x	
Chna	Chrysothamnus nauseosus			x
Chvi	C. viscidiflorus		0-20	20+
Cora	Coleogyne ramosissima		0-30	30+
Cost ²	Cornus stolonifera	x		
Cost	Cowania stansburiana	x		
Elar	Elaeagnus argentea		x	
Elca	E. canadensis		x	
Elro	E. rotundifolia		x	
Elut	E. utilis		x	
Ephz	Ephedra spp.		x	
Eran	Eriodictyon angustifolium			x
Eriz	Eriogonum spp.		x	
Eula	Eurotia lanata	x		
Fapa	Fallugia paradoxa		x	
Frdu	Franseria dumosa		x	
Fran	Fraxinus anomala		x	
Gafl	Garrya flavescens	0-10	11-20	20+
Gusa	Gutierrezia sarothrae			x
Hama	Haplopappus macronema		0-20	20+
Hodu	Holodiscus dumosus		x	
Juco	Juniperus communis		0-10	10+
Kapo	Kalmia polifolia	x		
Krgl	Krameria glandulosa		x	
Latr	Larrea tridentata		0-20	20+
Legl	Ledum glandulosum	x		
Loin	Lonicera involucrata	x		
Lout	L. utahensis	x		
Lycz	Lycium spp.		x	
Lysp	Lygodesmia spinosa		x	

R-4 RANGE ANALYSIS HANDBOOK

Symbol		Desirable	Intermediate	Least Desirable
FORBS				
Taof	Taraxacum officinale		0-10	10+
Thfe	Thalictrum fendleri		x	
Thmo	Thermopsis montana	0-5	6-20	20+
Traz	Tragopogon spp.			x
Triz	Trifolium spp.	0-5	5+	
Urtz	Urtica spp.		0-10	10+
Vaed	Valeriana edulis		x	
Vaoc	V. occidentalis	x		
Veca	Veratrum californicum		0-10	10+
Veth	Verbascum thapsus			x
Vicz	Vicia spp.	x		
Vimu	Viguiera multiflora		x	
Vioz	Viola spp.		x	
Vinul	V. nuttallii linguaefolia		0-10	10+
Wyam	Wyethia amplexicaulis		0-5	5+
Wyhe	W. helianthoides		0-5	5+
Zigz	Zigadenus spp. (General)		x	
	Z. spp. (Meadow)			x
SHRUBS				
Acez	Acer spp.	0-10	11-25	25+
Amal	Amelanchier alnifolia	x		
Ampr	A. prunifolia	x		
Apoz	Apocynum spp.		x	
Arcz	Arctostaphylos spp.		x	
Arpa	A. patula		0-50	50+
Arar	Artemisia arbuscula (Arar Type)	0-30	31-70	70+
	A. arbuscula (General)		0-25	25+
Arca	A. cana		0-10	10+
Arfr	A. frigida	0-5	6-20	20+
Artr	A. tridentata		0-10	10+
Artr ²	A. tripartita		0-10	10+
Atca	Atriplex canescens	x		
Atco	A. confertifolia	0-5	6-20	20+
Befr	Berberis fremontii		x	
Bere	B. repens		x	
Ceaz	Ceanothus spp.		x	
Cefe	C. fendleri	x		
Cegr	C. greggii	x		

R-4 RANGE ANALYSIS HANDBOOK

Symbol		Desirable	Intermediate	Least Desirable
FORBS				
Penz	Penstemon spp.	0-5	5+	
Peat	P. attenuatus		0-10	10+
Pepr	P. procerus	0-5	5+	
Pery	P. rydbergii		0-10	10+
Pesu	P. subglaber	0-5	5+	
Pewh	P. whippleanus	0-5	5+	
Phaz	Phacelia spp.		x	
Phlz	Phlox sp. (4 Arar)		0-10	10+
	P. spp. (General)		x	
Phyz	Physaria spp.		x	
Plaz	Plantago spp.			x
Polz ²	Polemonium spp.	0-5	6-30	30+
Pobi	Polygonum bistortoides	0-5	6-30	30+
Poph	P. phytolaccaefolium		0-10	10+
Potz	Potentilla spp. (General)		x	
	P. spp. (Meadow)		0-10	10+
Pobr	P. brevifolia	0-5	5+	
Pogl	P. glandulosa		0-10	10+
Pogl ²	P. glaucophylla	0-5	5+	
Popu	P. pulcherrima	0-5	5+	
Psmo	Pseudocymopterus montanus		x	
Ptaq	Pteridium aquilinum			x
Ranz	Ranunculus spp.		x	
Rate	R. testiculatus			x
Ruoc	Rudbeckia occidentalis		0-10	10+
Rumz	Rumex spp.		0-5	5+
Saxz	Saxifraga spp.		x	
Scrz	Scrophularia spp.		x	
Sedz	Sedum spp.		x	
Senz	Senecio spp. (General)			x
	S. spp. (Meadow)			x
Sein	S. integerrimus			x
Sese	S. serra	0-5	6-30	30+
Setr	S. triangularis	0-10	10+	
Sidz	Sidalcea spp.	x		
Sian	Sisyrinchium angustifolium		x	
Smiz	Smilacina spp.		x	
Solz	Solidago spp.		x	
Sope	S. petradoria			x
Sphz	Sphaeralcea spp.		x	
Stja	Stellaria jamesiana			x

R-4 RANGE ANALYSIS HANDBOOK

Symbol		Desirable	Intermediate	Least Desirable
FORBS				
Ilri	Iliamna rivularis		x	
Irmi	Iris missouriensis		0-10	10+
Ivax	Iva axillaris			x
Lapz	Lappula spp.		x	
Latz	Lathyrus spp.	0-5	6-20	20+
Laut	L. utahensis	x		
Lepu	Leptodactylon pungens		x	
Lesz	Lesquerella spp.			x
Lewz	Lewisia spp.		x	
Ligz	Ligusticum spp.	x		
Lifi	L. filicinum	0-5	6-20	20+
Lipo	L. porteri	0-5	6-20	20+
Linu	Linanthastrum nuttallii			x
Lile	Linum lewisii	x		
Liru	Lithospermum ruderales		x	
Lomz	Lomatium spp.		x	
Lodi	L. dissectum		0-10	10+
Lonu	L. nuttallii		0-10	10+
Losi	L. simplex		0-10	10+
Lotr	L. triternatum	x		
Lotz	Lotus spp.		x	
Lupz	Lupinus spp.	0-5	6-20	20+
Luki	L. kingii			x
Lysp	Lygodesmia spinosa		x	
Mavu	Marrubium vulgare			x
Menz	Mentha spp.		x	
Menz ²	Mentzelia spp.		x	
Merz	Mertensia spp.	0-20	21-40	40+
Mebr	M. brevistyla	x		
Meci	M. ciliata	0-20	21-40	40+
Mele	M. leonardi	0-20	21-40	40+
Mimz	Mimulus spp.		x	
Mood	Monardella odoratissima		x	
Mudi	Musineon divaricatum		x	
Oenz	Oenothera spp.		x	
Ortz	Orthocarpus spp.			x
Osdi	Osmorhiza divaricata		x	
Osob	O. obtusa		x	
Osoc	O. occidentalis (General)	0-20	21-40	40+
	O. occidentalis (6-Cage)	0-10	10-30	30+
Oxyz	Oxytropis spp.		x	
Pabr	Paeonia brownii	x		
Pedz	Pedicularis spp.		x	

R-4 RANGE ANALYSIS HANDBOOK

Symbol		Desirable	Intermediate	Least Desirable
FORBS				
Ditr	D. trachycarpum		x	
Dodz	Dodecatheon spp.		x	
Draz	Draba spp. (Perennial)		x	
Epiz	Epilobium spp.		x	
Epan	E. angustifolium		x	
Eqar	Equisetum arvense			x
Eriz ²	Erigeron spp. (General)		x	
	E. spp. (Meadow)		x	
Erfl	E. flagellaris			x
Ersp	E. speciosus	1-5	5+	
Eriz	Eriogonum spp. (Sage-grass type)		0-10	10+
	E. spp. (General)	0-10	10+	
Erla	Eriophyllum lanatum		x	
Erci	Erodium cicutarium		x	
Eras	Erysimum asperum	x		
Escz	Eschscholtzia spp.		x	
Fraz	Fragaria spp.		x	
Frmo	Fraseria montana		x	
Frsp	F. speciosa		x	
Friz	Fritillaria spp.	x		
Gabo	Galium boreale		x	
Genz	Gentiana spp.		x	
Gerz	Geranium spp.	0-5	6-25	25+
Gefr	G. fremontii	0-5	6-25	25+
Geri	G. richardsoni	0-5	6-25	25+
Gevi	G. viscosissimum	0-5	6-25	25+
Gema	Geum macrophyllum		x	
Getr	G. triflorum		x	
Gilz	Gilia spp.		x	
Hacz	Hackelia spp.		x	
Hafl	H. floribunda	0-5	5+	
Hapz	Haplopappus spp.		x	
Hedo	Hedysarum boreale	x		
Heho	Helenium hoopesii			x
Heun	Helianthella uniflora	0-10	10+	
Hela	Heracleum lanatum	x		
Heuz	Heuchera spp.	x		
Hiez	Hieracium spp.	x		
Hofu	Horkelia fusea		x	
Hyca	Hydrophyllum capitatum		0-5	5+
Hymz ²	Hymenoxys spp.		x	
Hyfl	H. floribunda			x
Hype	Hypericum perforatum			x

R-4 RANGE ANALYSIS HANDBOOK

Symbol		Desirable	Intermediate	Least Desirable
FORBS				
Antz	Antennaria spp.			x
Aquz	Aquilegia spp.	x		
Ardr	Arabis drummondii		x	
Arez	Arenaria spp.			x
Arnz	Arnica spp. (General)		x	
	A. spp. (Meadow)			x
Arco	Arnica cordifolia	x		
Arlo	A. longifolia		x	
Artz	Artemisia spp. (Other herb.)		x	
Arlu	A. ludoviciana		0-20	20+
Astz ²	Aster spp. (General)		x	
	A. spp. (Meadow)			x
Asch	A. chilensis		0-20	20+
Asen	A. engelmanni	x		
Asfo	A. foliaceus		x	
Asin	A. integrifolius		x	
Astz	Astragalus spp.		x	
Asdi	A. diversifolius	x		
Baho	Balsamorhiza hookeri		x	
Bama	B. macrophylla	0-20	20+	
Basa	B. sagittata	0-20	20+	
Calz	Calochortus spp.	x		
Cale	Caltha leptosepala	0-5	5+	
Caqu	Camassia quamash	x		
Camz	Campanula spp.		x	
Casz	Castilleja spp. (General)	x		
	C. spp. (Meadow)		x	
Chdo	Chaenactis douglasii		x	
Chvi	Chrysopsis villosa			x
Cicz	Cicuta spp.		x	
Cirz	Cirsium spp.			x
Claz	Claytonia spp.		x	
Clez	Clematis spp.		x	
Colz	Collomia spp.			x
Copa	Comandra pallida			x
Coca	Corydalis caseana		x	
Crez	Crepis spp.	x		
Cryz	Cryptantha spp.		x	
Cyof	Cynoglossum officinale			x
Delz (T)	Delphinium spp. (Tall)	0-10	10+	
Delz (L)	Delphinium spp. (Low)		x	
Dior	Disporum oregonum		x	

R-4 RANGE ANALYSIS HANDBOOK

Symbol		Desirable	Intermediate	Least Desirable
GRASSES				
Pose	P. secunda (General)		0-20	20+
	P. secunda (Low sagebrush community)	0-10	10-30	30+
SiHy	Sitanion hystrix		x	
Stiz	Stipa spp.		x	
Stco ²	S. columbiana	0-20	20+	
Stco	S. comata	x		
Stle	S. lettermani		0-50	50+
Stoc	S. occidentalis	x		
Stsp	S. speciosa		x	
Trsp	Trisetum spicatum	x		
GRASSLIKE PLANTS				
Carz	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		x	
Caro	C. rossii		x	
Elez	Eleocharis		x	
Junz	Juncus spp. (Other)	x		
Junz(a)	J. spp. (Annual)			x
Juba	J. balticus		x	
Judr	J. drummondii		x	
Luzz	Luzula spp.	x		
FORBS				
Acla	Achillea lanulosa (General)		x	
	A. lanulosa (Meadow)			x
Acco	Aconitum columbianum	x		
Agur	Agastache urticifolia	0-5	6-30	30+
Agoz	Agoseris spp.		0-1	10+
Allz	Allium spp.			x
Anaz	Anaphalis spp.			x
Angz	Angelica spp.	x		
Annz	Annual forbs			x

*Toiyabe N.F.

R-4 RANGE ANALYSIS HANDBOOK

Symbol		Desirable	Intermediate	Least Desirable
GRASSES				
Elyz	Elymus spp.	x		
Elci	E. cinereus	0-30	30+	
Elgl	E. glaucus	0-10	10+	
Elsi	E. simplex	0-20	21-40	over 40
Eltr	E. triticoides	0-30	30+	
Fesz	Festuca spp.	x		
Fesz(a)	F. spp. (Annuals)			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+	
Glyz	Glyceria spp.	x		
Glbo	G. borealis	x		
Gler	G. erecta	x		
Heki	Hesperochloa kingii	x		
Hija	Hilaria jamesii	x		
Hola	Holcus lanatus		x	
Hobr	Hordeum brachyantherum		x	
Huju	H. jubatum			x
Kocr	Koeleria cristata	x		
Melz ²	Melica spp.		x	
Mebu	M. bulbosa	0-5	6-20	20+
*Mefu	M. fugax		x	
Mesp	Melica spectabilis	0-5	6-20	20+
Mest	M. stricta	x		
Mufi	Muhlenbergia filiformis		0-5	5+
Mumo	M. montana	0-30	30+	
Muri	M. richardsonis		0-5	5+
Oryz	Oryzopsis spp.	x		
Orhy	O. hymenoides	x		
Phal	Phleum alpinum	x		
Phpr	P. pratense	x		
Poaz	Poa spp. (Other)	x		
Pobu	P. bulbosa		0-20	20+
Pofe	P. fendleriana	x		
Popr	P. pratensis		x	
*Toiyabe N.F.				

R-4 RANGE ANALYSIS HANDBOOK

Exhibit 41.21-C

SPECIES LIST

General

Symbol		Desirable	Intermediate	Least Desirable
GRASSES				
Agrz	Agropyron spp.	0-30	30+	
Agcr	A. cristatum	x		
Agin	A. inerme	0-30	30+	
Agsa	A. saxicola	0-30	30+	
Agsm	A. smithii	0-20	20+	
Agsp	A. spicatum	0-30	30+	
Agsu	A. subsecundum	x		
Agtr	A. trachycaulum	0-10	10+	
Agrz ²	Agrostis spp.	x		
Agal	A. alba	x		
Agdi	A. diegoensis	0-40	40+	
Agsc	A. scabra		x	
Bltr	Blepharoneuron tricholepis		x	
Bogr	Bouteloua gracilis	x		
Briz	Briza spp.		x	
Broz	Bromus spp. RRC	x		
Bran	√B. anomalus	x		
Brca	B. carinatus		x	
Brci	B. ciliatus	x		
Brin	√B. inermis	x		
Brma	√B. marginatus	0-5	5-25	25+
Brte	√B. tectorum			x
Broz (a)	Other annual bromus			x
Caca	Calamagrostis canadensis	0-20	20+	
Capu	C. purpurascens	x		
Caru	C. rubescens	0-40	40+	
Dagl	Dactylis glomerata	x		
Danz	Danthonia spp.	x		
Daca	D. californica	x		
Dain	D. intermedia	x		
Daun	D. unispicata		x	
Deca	Deschampsia caespitosa	0-40	40+	
Deda	D. danthonioides			x
Deel	D. elongata			x

R-4 RANGE ANALYSIS HANDBOOK

Shrubs
Percent Airdry Weight

	STAGES OF DEVELOPMENT				
	Early Leaf	Flowering	Mature Foliage	Late Season	Winter
<i>Acer glabrum</i>	30				
<i>Amelanchier alnifolia</i>		35	40		
<i>Artemisia arbuscula</i>			54		
<i>A. canescens</i>			41		
<i>A. tridentata</i>	35	39	50		60
<i>Chrysothamnus viscidiflorus</i>		45	55-60		
<i>Pachistima myrsinites</i>			43		
<i>Physocarpus malvaceus</i>				74	
<i>Prunus virginiana</i>			43	69	
<i>Purshia tridentata</i>		40			
<i>Quercus gambelii</i>			50		
<i>Rosa</i> sp.		35	35		
<i>Sambucus</i> sp.			22		
<i>Symphoricarpos</i> spp.		35	40		
<i>Tetradymia canescens</i>			55		

R-4 RANGE ANALYSIS HANDBOOK

Forbs
Percent Airdry Weight

	STAGES OF DEVELOPMENT				
	Pre-bloom	Bloom	Soft Seed	Seed Maturity	Curing
Lupinus spp.	23-25	25	30	30	33
L. argenteus		25	30	35	
Mertensia leonardi	18	20	22	22	
Microseris sp.	19				
Orthocarpus spp.					
Osmorhiza occidentalis		21	25		
Penstemon sp.		25	28	35	
Potentilla sp.				38	
Rudbeckia occidentalis	21-25	25			
Senecio integerrimus		18			
S. serra	18-25	28-30	35		38
S. uintahensis			25		
Stellaria jamesiana	23		31	31	
Thalictrum fendleri		30	36	38	
Valeriana occidentalis		20		25	
Vicia americana		25	30	30	
Viguiera multiflora		30	35		
Viola spp.					
Wyethia amplexicaulis	25	30	35	40	

R-4 RANGE ANALYSIS HANDBOOK

Forbs
Percent Airdry Weight

	STAGES OF DEVELOPMENT				
	Pre-bloom	Bloom	Soft Seed	Seed Maturity	Curing
<i>Achillea lanulosa</i>	22-25	27	30	35	60
<i>Actaea arguta</i>	20				
<i>Agastache urticifolia</i>	25	30			
<i>Agoseris</i> spp.	17				
<i>Artemisia ludoviciana</i>				36	
<i>Aster</i> spp.	27	35	40		
<i>A. adscendens</i>				34	
<i>A. foliaceus</i>			30	34	
<i>Astragalus</i> sp.			25		
<i>Balsamorhiza sagittata</i>	20	30	35	40-50	
<i>Castilleja</i> spp.	25	27	30	35	
<i>C. linariaefolia</i>				39	
<i>Crepis</i> spp.	25	30	35		
<i>Delphinium occidentale</i>	22	28			
<i>Erigeron</i> spp.		25			
<i>E. speciosus</i>			33	35	55+
<i>Eriogonum umbellatum</i>			40		
<i>Frasera speciosa</i>		20	20		
<i>Geranium</i> spp.	21	24	24	26-30	
<i>Hackelia floribunda</i>			27		
<i>Haplopappus parryi</i>		22	28	35	
<i>Helianthella uniflora</i>	21				
<i>Heracleum lanatum</i>		20	20	22	
<i>Hieracium albertinum</i>				34	
<i>Lathyrus</i> spp.		25	29		50
<i>L. leucanthus</i>			29		
<i>Ligusticum porteri</i>			30		
<i>Lithospermum ruderales</i>		28			
<i>Lomatium nuttallii</i>			26	37	

R-4 RANGE ANALYSIS HANDBOOK

Exhibit 41.21-B

DRY WEIGHT CONVERSION TABLES

Grasses and Grasslike

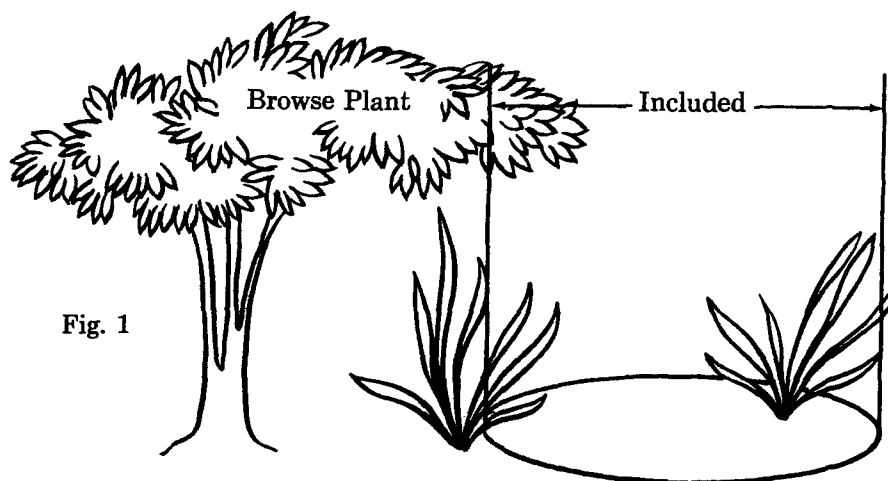
Percent Airdry Weight

	STAGES OF DEVELOPMENT					
	Leaf	Boot	Bloom	Dough	Seed Maturity	Curing
<i>Agropyron cristatum</i>	27			50	60	
<i>A. inerme</i>		38	45		50-60	85-90
<i>A. spicatum</i>		36	40	45	55-65	
<i>A. subsecundum</i>				45	50-60	
<i>A. trachycaulum</i>			35	45	50-60	
<i>Arrhenatherum elatius</i>			30-35			
<i>Bromus inermis</i>	30			30-35	35-40	
<i>B. marginatus</i>			30	35	40	
<i>B. tectorum</i>	25	30	35	50	60	
<i>Carex aquatilis</i>				37	37	
<i>C. geyeri</i>	45	50	50	55	60	
<i>Elymus cinereus</i>	40	40	45	50	60-70	
<i>E. glaucus</i>			30	40		
<i>Eleocharis</i> sp.					38	
<i>Festuca idahoensis</i>	30	35	40	45-50	50-60	
<i>F. ovina</i>	30	35	40	45-50	50-60	
<i>F. thurberi</i>				55	60	
<i>Juncus</i> sp.				33		
<i>Melica bulbosa</i>				45	50	
<i>Poa fendleriana</i>	30			35	40	
<i>P. pratensis</i>	25		27	35	45	
<i>P. secunda</i>	25	35	40	50	43	70-90
<i>Sitanion hystrix</i>	30	35		60		
<i>Stipa columbiana</i>			40-45	45-50		
<i>S. lettermani</i>			40	50	60	
Wet meadow (all sp.)				26		

R-4 RANGE ANALYSIS HANDBOOK

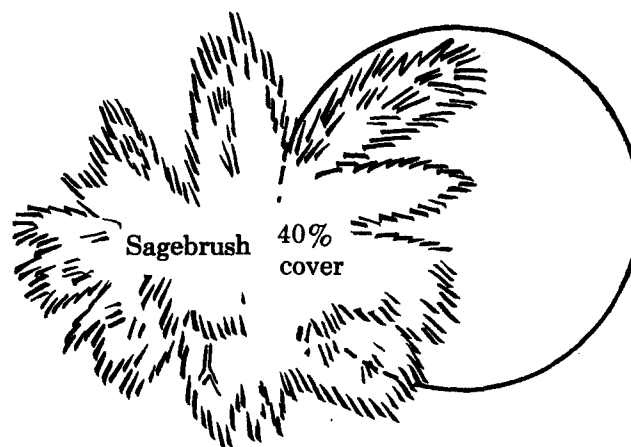
Exhibit 41.21-A

CROWN COVER AND GROUND COVER ILLUSTRATIONS



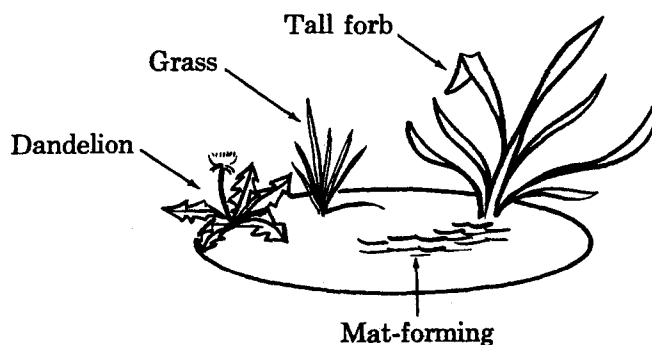
Estimates include all portions of plants within the plot. The upright lines illustrate portions considered in the estimate.

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.

R-4 RANGE ANALYSIS HANDBOOK

SOIL: SURFACE TEXTURE Silt loam; THICKNESS 8"; pH 6.0
 SUBSOIL TEXTURE v. st. clay; THICKNESS 22"; pH 7.0
 SUBSTRATUM MATERIAL Caliche sandstone; EFFECTIVE ROOTING DEPTH 29"
 REMARKS stominess 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 1/2 of the type

INHERENT EROSION HAZARD: DETACHABILITY RATING 7; SURFACE COVERED WITH ROCK FRAGMENTS $\frac{1}{2}$ INCH OR GREATER
 IN DIAMETER 0 %; ADJUSTED DETACHABILITY RATING 7
 PROFILE PERMEABILITY RATING 7; SOIL ERODIBILITY INDEX 49; CLASS IX
 SLOPE 35-40 %; INHERENT EROSION HAZARD, CLASS IX

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

COVER DISPERSION: UNIFORM — FAIRLY UNIFORM V 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:

AIR-DRY CONTENT OF GREEN FORAGE

GRASSES & SEDGES

MUST 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%

CALCULATIONS

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

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

R-4 RANGE ANALYSIS HANDBOOK

Exhibit 41.2

SITE ANALYSIS

WRITEUP NO. T-4		SITE ANALYSIS						PHOTO NO. CVW-9V-15	
FOREST Bannock		RANGER DISTRICT Indian Head		ALLOTMENT Coyote Creek		EXAMINER Wm. Thompson		DATE 8/14/63	
TRANSECT NO. 1 of 1		PLOT SIZE 9.6		PLOT INTERVAL 1 ch		TYPE DESIGNATION S5-34		KIND OF LIVESTOCK sheep	
LOCATION In the head of Birch Cr.		SLOPE 35%		ASPECT W		ELEVATION 9,500			

SPECIES	PLOTS										TOTAL PROD.	GRAMS USED	% UTIL.	DRY WT. PROD.	PCT. COMPOSITION	DESIRABILITY RATING
	1	2	3	4	5	6	7	8	9	10						
GRASSES																
<i>Braa</i>	20		1		5	5	5	5	4	3	48			24	1	D
<i>Agtr</i>	12	20	2			4	10	10	15	5	78			39	2	D
<i>Meku</i>		3	1								4			2	T	D
<i>Stle</i>					40						40			20	1	I
<i>Pore</i>			2								2			1	T	D
Total grass											172			86	4	
FORBS																
<i>Poco</i>	110	110	40	3		45	25	70	4	10	507			152	9	D-5.5
<i>Hafi</i>	15	25	8		2	140				10	200			60	4	D
<i>Coli</i>	4		1	5						6	16			5	T	I
<i>Stja</i>	5	5	3	4	4	6	18		4		49			15	1	I
<i>Vipu</i>	3	15	4	3	8	15	20	10	4	15	97			29	2	I
<i>Agpu</i>	3										3			1	T	L
<i>Tufe</i>	8	5		5		35	15				68			20	1	I
<i>Acla</i>	4					10					14			4	T	I
<i>Pedo</i>	2		5	20	3		15		6		57			15	1	I
<i>Chal</i>		5						3			8			2	T	I
<i>Orin</i>		3	4	8	2		8	15	6	15	61			18	1	I
<i>Magl</i>			1	25	20				40		86			26	2	L
<i>Debr</i>			T								T			T		
<i>Lual</i>					6						6			2	T	D
<i>Actz</i>					3						3			1	T	I
<i>Heho</i>						70					70			21	1	L
<i>Pofi</i>						6					6			1	T	I
<i>Vimu</i>	10	35	15	3	8	25	30	30	5	25	186			56	3	I
Total forbs											1431			428	25	
BROWSE																
<i>Artr</i>	130										130			65	4	I
<i>Samz</i>	45	450	40	25		810	720	600	60	480	3230			1130	67	D-10.5 L-42
Total browse											3360			1195	71	
Total														1709	100	
100%																
% OVERSTORY (TREES)											Average				22	% DESIRABLE
% OVERSTORY (SHRUB)	20	65	20	15		100	90	85	25	60	53				33	% INTERMEDIATE
% CROWN COVER (HERB)															-45	% LEAST DESIRABLE
% BARE GROUND	40	15	70	80	30	20	20	35	70	35	44					CONDITION RATING:
% ROCK & PAV (NAT.)															14	COMPOSITION RATING
% ROCK & PAV (UNNAT.)															22	PRODUCTION RATING
% VEG. & LITTER	60	85	30	20	70	80	80	65	30	65	56				36	FORAGE CONDITION RATING
% SOIL DISTURBANCE															25	GROUND COVER INDEX
DROPPINGS															33	CURRENT EROSION INDEX
PELLET GROUPS															58	SOIL CONDITION RATING

* 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 →