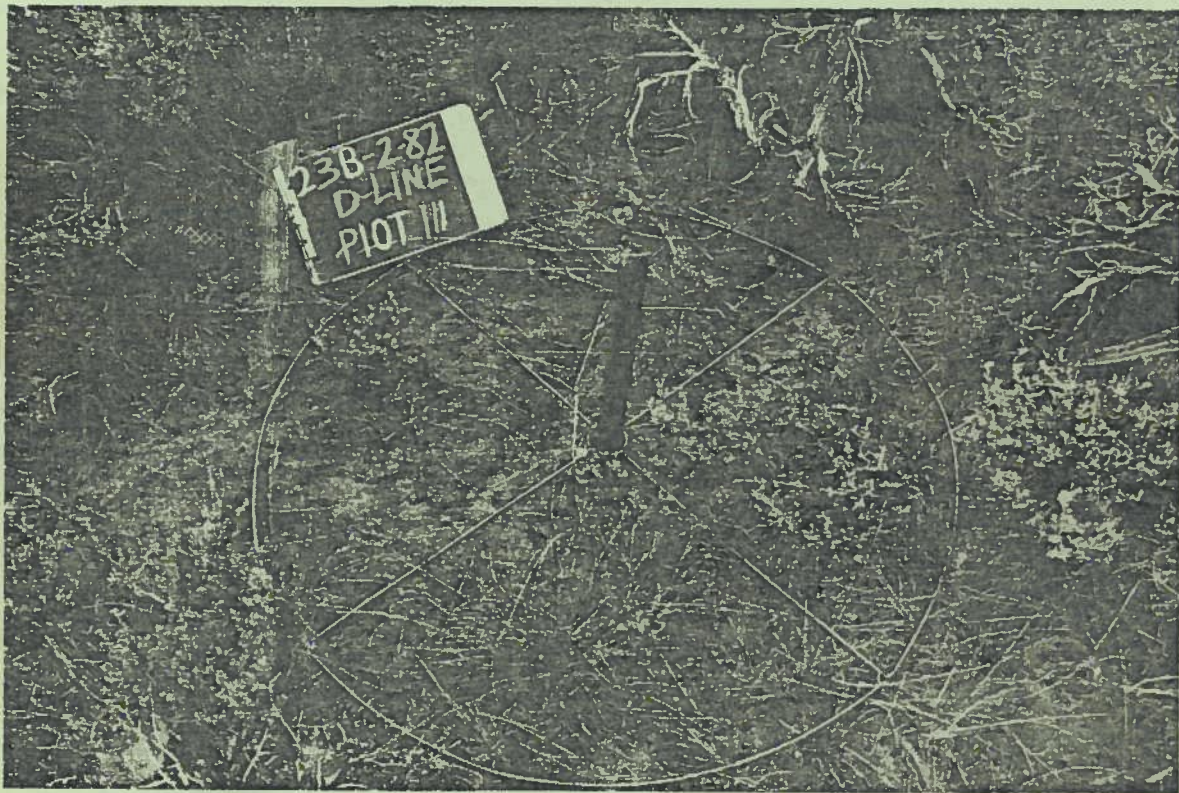
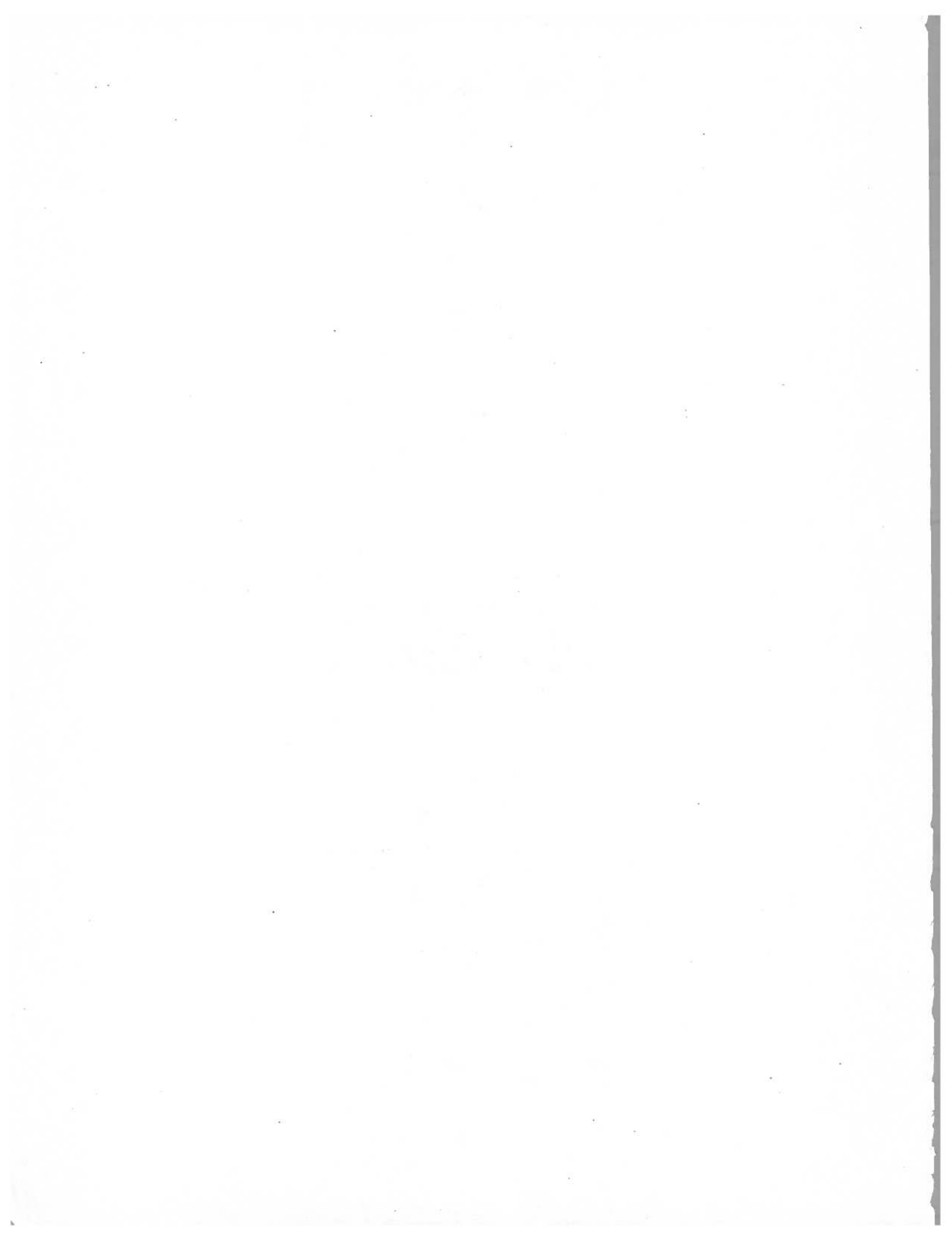


**A MANUAL OF
UTAH BIG GAME RANGE
TREND STUDY GUIDELINES**



**prepared by
Utah State Interagency Committee**

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GUIDELINES
FOR
BIG GAME RANGE TREND MONITORING
(INTERAGENCY RANGE TREND STUDY PROCEDURE)

Prepared By
UTAH STATE INTERAGENCY COMMITTEE
January, 1983

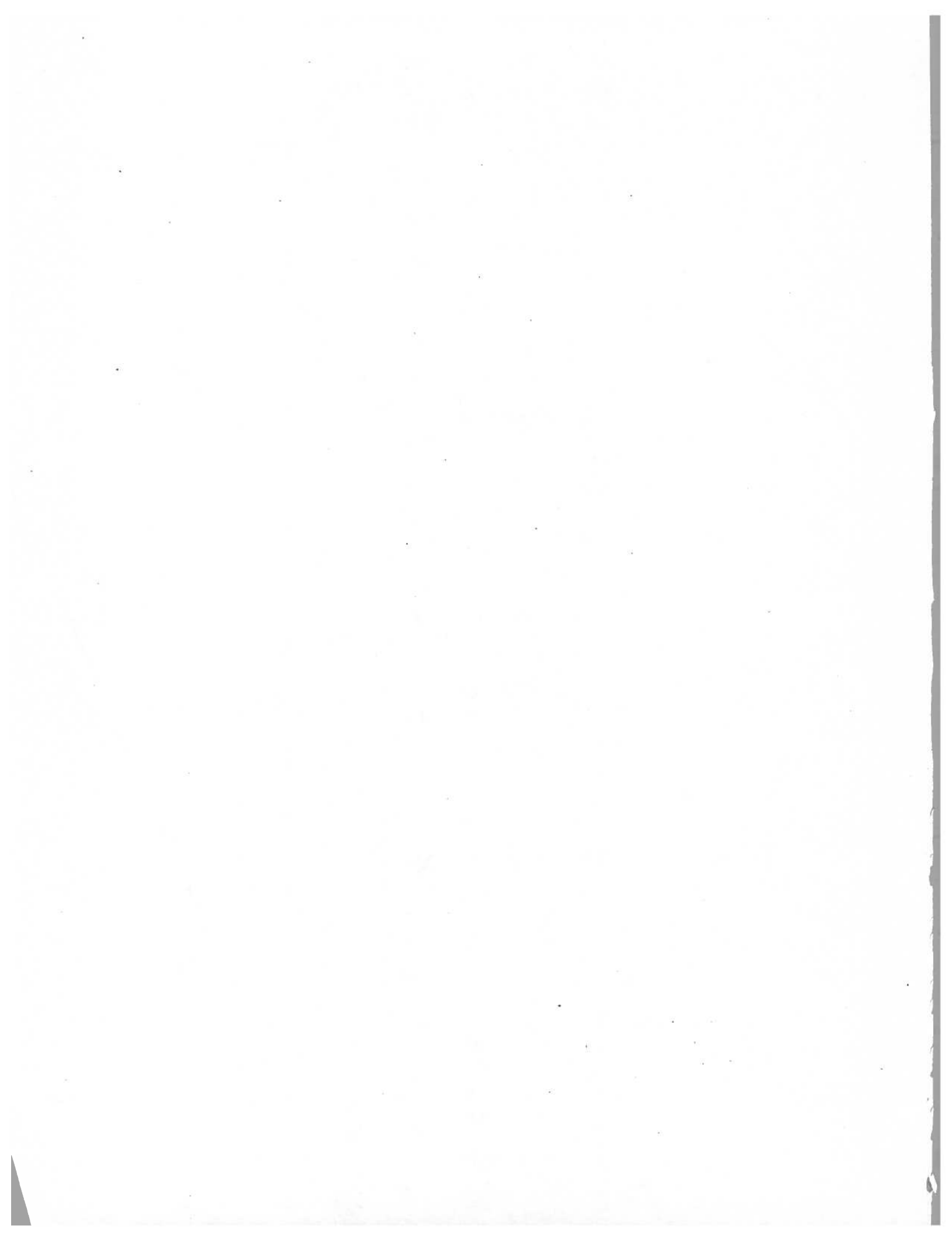
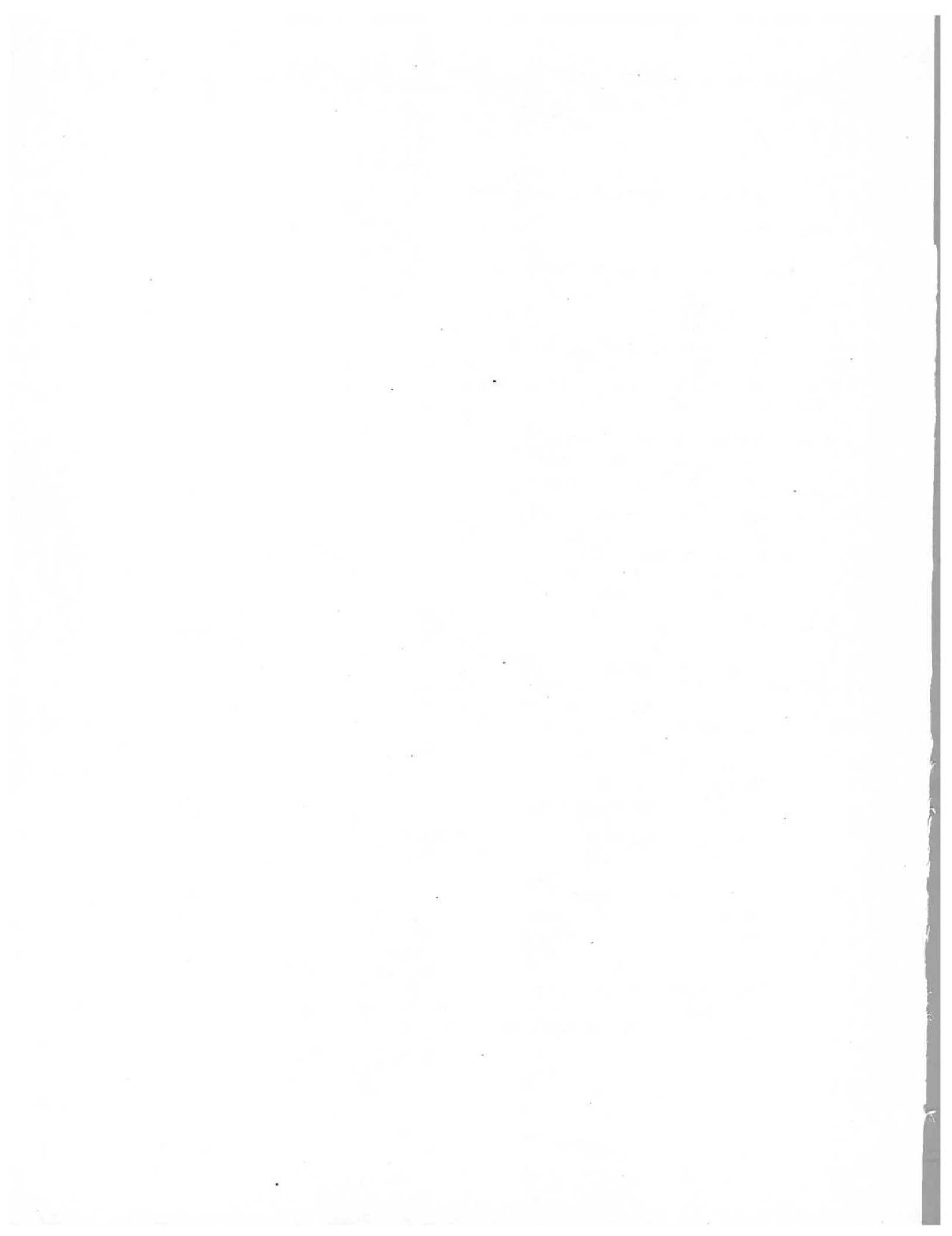


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TO: Local Interagency Personnel of the: U.S.F.S.
D.W.R.
B.L.M.

The accompanying Interagency Committee Big Game Range Trend Study Guidelines have been developed during the course of the past year after considerable time and team effort. You will recall that these guidelines were developed by representatives of the U.S.F.S.'s Region 4 Range Staff, the State B.L.M. Range Staff and D.W.R.. Bruce Giunta, in charge of DWR's Range Inventory, headed this coordination effort. We specifically express our appreciation to Bruce, Harold Edwards and George Martinez - U.S.F.S., Merrill Despain and Steven Leonard - B.L.M. and Ben Norton - U.S.U. We are keenly appreciative of this team's effort to function as an ad hoc committee to the State Big Game Interagency Committee in this important matter. We also appreciate suggestions from several of you as the review team developed the methodology.

The option to establish these permanent trend plots is largely yours, at the local interagency level. Some of you earlier expressed the desire to set these plots up yourself as a local interagency effort. You did so primarily on the basis of wanting to establish the plots in a more timely manner. Others have asked Bruce Giunta and his summer range crew to handle the establishment of these plots in their area. An additional way could be utilized. We see no reason why there could not be a cooperative pooling of DWR and agency range people from on-going or new programs. This could be affected as you establish priorities and build new budgets.

(1)

Local Interagency Personnel
October 29, 1982
Page two

We hope the accompanying Range Trend Study Guidelines will aid you in better understanding the vegetative trend monitoring methods recommended and help you as a local interagency to implement trend monitoring as you might elect to do.

STATE INTERAGENCY COMMITTEE

Paul Shields
Jerry Farringer
Norman Hancock

cc: Board of Big Game Control
DWR Regional Supervisors
U.S.F.S. Forest Supervisors
B.L.M. District Managers
Dr. Ben Norton, USU Range Science Dept.

All Interagency Personnel (would the respective Forest Supervisors, BLM District managers and DWR Regional Supervisors please see that your respective local interagency personnel receive a copy of this material.)

INTRODUCTION

Within the last several years, it has become apparent that there is a dire need for accurate and reliable range trend data on big game ranges in Utah. Until about 1977, the Division of Wildlife Resources paid scant heed to this aspect of habitat management. It was known, of course, that a number of "Parker 3-Step" and "Cottam-Davis" photo transects were in place around the state, but these data were never seriously utilized for big game management purposes. Aside from some technological deficiencies, most were not strategically located on big game ranges. For almost 30 years, the Division has conducted an annual "Big Game Range Inventory" on the various deer herd units. After the entire state had been inventoried once, it was felt that perhaps redoing inventories again years later might provide an assessment of trend. Beginning in the mid-1970's, this was done, but it became immediately apparent that no accurate trend assessment was possible. There were several reasons for this. Perhaps most important was that, prior to 1977, no permanently located transects were involved. Thus, any comparisons made or conclusions drawn from two inventories conducted years apart were on shaky ground from the outset. A second factor was that the sampling procedure used was not designed primarily as a trend monitoring technique. Rather, it was an inventory procedure that could be modified to provide trend data. Beginning in 1977, the Division's range inventory project began establishing permanent line-intercept transects on selected herd units.

However, it has since become apparent that trend studies are not entirely compatible with the need to simultaneously conduct a forage inventory. This has to do primarily with transect locations. Inventories require extensive

and representative sampling efforts. Trend studies, on the other hand, require more careful and purposeful selection of study sites. Something better was needed!

Beginning in 1980, after the Board of Big Game Control charged the Interagency Committee to develop individual deer herd unit management plans, a consensus developed among Interagency people that range trend evaluations would be an important part of these plans. A full-blown Interagency trend procedure was needed. Accordingly, a meeting of the State Interagency Committee, agency and university personnel was held in July, 1981 in Salt Lake City to discuss range trend study procedures and the possibility of developing a uniform method that would be acceptable to all concerned. The upshot of this meeting was that a subcommittee was appointed and charged with this responsibility. Subcommittee members included Harold Edwards and George Martinez from the U. S. Forest Service, Merrill Despain from the BLM, Bruce Giunta from the DWR, and Dr. Ben Norton from the USU Range Science Department.

After a number of meetings and consultations and the preparation of a preliminary set of draft guidelines, the full Interagency Committee met on April 26, 1982, and tentatively agreed upon the following points:

1. Selection and workup of proposed range trend study sites are of critical importance and should be performed by the local Interagency Committee. It is essential that this be a cooperative Interagency effort. This implies a sharing of existing data and also joint reconnaissance of prospective sites.

Sites should be selected on the basis of need and feasibility of establishment and rereading. In addition, prospective study sites should be representative of critical range areas under consideration.

Duplication of existing trend studies, if located on acceptable sites, should be strictly avoided. All of these factors will influence the number of studies that may be established within a given DWR Region, National Forest, or BLM district.

Once prospective study sites have been selected, prioritized and hopefully scheduled for study establishment, the more difficult task of characterizing sites remains. Much of this work will involve gathering and evaluating already existing information on soils, precipitation, animal use, vegetative potential and past management history. What all of this should lead to is development of written and jointly agreed upon estimates of site potential. Once this is done, a management objective specific to each study site can be formulated. This is a critical part of the whole process because the management objective will be the standard against which trend will be assessed in the future. Formulating a management objective will require designating key species, desired plant composition, ground cover and a variety of other factors. More detailed guidelines and suggestions on site selection and characterization can be found in the manual section of that title.

2. Each region of the DWR and the local Interagency personnel concerned should prepare a detailed and prioritized list of proposed study sites. This should also include any "comparison areas" intended for use in helping to formulate site potential and initial management objectives.

3. Three options relating to trend study methodology will be available to local Interagency personnel. Although there are no hard and fast rules with respect to the option chosen, the following guidelines were agreed upon:

a. When local Interagency personnel choose to conduct studies and particularly when Forest Service or BLM biologists, etc., actively participate, the category of landownership shall be of great importance. If, for example, a study is to be established on BLM administered land, the method employed will be the plant density/characterization procedure currently being used by the BLM in Utah. If the study is on National Forest land, the Forest Service nested frequency sampling procedure should be used. Both of these methods will be used without significant modification. Pertinent excerpts from the respective manuals are included as a part of this manual. When either of these methods is used, the appropriate federal agency will provide the necessary data forms, manuals and equipment necessary to do the study. Copies of all completed data forms, write-ups photographs, etc., relating to the study will be provided to the DWR for inclusion in deer herd unit management plans, an annual report of big game trend studies in Utah, or to be included in the Big Game Handbook for that year.

Both Federal agency methods are intended to be minimum requirements on big game range study sites. If it is thought that additional data are needed, a third option may be employed. This option is a combination of Forest Service and BLM methodologies. Be aware, however, that the combination or compromise method is not

simply a duplication of its two constituent parts. there are some changes and modifications, but they are not so great as to render the data collected uncomparable with that collected with either Forest Service or BLM methodologies when used alone.

On state and private lands, the choice of method is left to the discretion of local interagency personnel.

b. On study sites where the DWR's Range Trend Study crew is the primary investigator, the project leader will choose between any of the three options, however, he or she should attempt to coordinate closely with the local Interagency Committee and accomodate their desires. As a matter of practice, it is envisioned that the DWR range crew will be employed as a roving range trend study crew that can be used on a need or priority basis to establish new trend studies or reread already existing studies.

4. Range Trend Studies established by Interagency personnel are intended primarily as a big game management tool. Such studies, because location is so important, should be in addition to existing studies already in place on grazing allotments, etc. However, in many cases, it may be possible to use existing trend studies for big game management purposes. This should be done whenever possible.

If local Interagency personnel elect to establish permanent trend transects it will be essential that they become reasonably proficient in plant species identification. Several solutions exist:

- A. Plant identification training can be provided.
- B. Have an "expert" along when the study is established or reread.
- C. Conscientiously utilize a procedure for collecting specimens for later identification by an "expert".

SITE SELECTION AND CHARACTERIZATION

Local Interagency personnel (i.e., game managers, conservation officers, range conservationists, district rangers, etc.) must cooperate closely in selecting sites on big game range where trend monitoring studies are to be conducted. The importance of careful site selection cannot be over-emphasized. In general, several steps and criteria should be followed.

They are:

1. Identify and prioritize the critical big game ranges in the area of responsibility.

2. Identify and list the various range types that occur there.

3. Make decisions as to which range types should be monitored.

This may depend on a variety of factors, such as livestock and big game use, perceived forage condition for livestock and/or big game, an expectation of vegetational change or even a planned change in management. Another factor would be the presence or absence of usable trend studies already in place.

4. Select actual monitoring locations. These must fall within a single, relatively homogenous type, large enough to ensure that no part of the monitoring layout falls outside type boundaries. Generally speaking, selected locations should be representative or indicative of a larger range area. Thus, it is best to avoid extremely depleted areas or sites that are obviously in better condition than the range type as a whole. Be certain also that selected sites contain at least some individuals of the key plant species. In most cases, on big game range,

this will be a shrub(s) but occasionally may be a grass or forb. Another item to consider is ease of documentation. Remember that the location must be described so that a perfect stranger can find and reread the study in the future. Select sites that are away from undue disturbance (i.e., roads, buildings, etc.) but that, at the same time, can be precisely described and documented.

5. Characterize the selected site so that eventually a site potential and management objective specific for that site can be written. Some basic information needs include:

- a. What class of animals are currently using it, those which may in the future, and a target for carrying capacity.
- b. Past use or abuse.
- c. Soils information--may be available from SCS files, BLM, SVIM data or Forest Service sources.
- d. Site-specific climatic and topographic information that would influence vegetative potential.
- e. The probable ecologic "climax" community.

Not all listed information may be immediately available, but every effort should be made to collect it prior to the second reading of a trend study.

6. Make an estimate of site potential.

- a. This may be stated in either ecological or empirical terms. In the latter instance, use the data parameters measured in the range trend study procedure (i.e., plant density, frequency, etc.).

b. The information from 5 above will form the basis for determining a site potential.

c. Remember that "site potential" will likely be an unreachable state under current or proposed management. Its primary function is to allow the formulation of reasonable management objectives against which trend can be assessed in the future. The proposed management objective must be achievable.

7. Formulate a site-specific management objective based on estimated potential, the needs of the number and species of animals being managed for and further tempered by the principles of sustained yield and nondegradation of other resource values associated with the site. Management objectives should be defined and written down in the following terms:

a. Desired plant community or range type when objective is reached. Most often there will be no change but, in some cases, a type conversion through management may be a realistic goal. The desired makeup of the community in terms of the mix of shrubs, forbs and grasses should be stated in both frequency and/or density terms. If information regarding species desirability and allowable occurrences or preferred density limits has been developed in the objective, these goals should also be a part of the objective.

b. Desired frequency, density, age structure and form class structure of the major or "key" plant species.

c. Allowable limits of ground cover.

Determining a management objective and quantifying it will not be an easy task; however, it will become increasingly necessary in the years

ahead. It is not intended that the objective be static. On the contrary, as more and better information about a particular site is collected, it will be necessary to periodically refine the management objective. One suggestion that may provide a logical starting point is the use of a "comparison area." Presumably, this would be a site with a similar potential as the one intended for study. The comparison area would also have to be in near optimum vegetative condition. In effect, it would be an on-the-ground example of what the study site would be like if it were at or near the management objective or even the site potential. The comparison area could then be sampled using the range trend study procedure to obtain comparison data that could be used as a standard to develop a management objective against which trend could be measured. Suitable comparison areas may not always be available in near proximity to the primary study site, but if there are, it would be good to utilize them. Obviously, there is a degree of subjectivity involved in selecting such areas, but it is likely that no one can do a better job of it than local Interagency personnel.

GUIDELINES FOR DETERMINING INTENSITY OF ANIMAL USE
ON THE FORAGE RESOURCE

I. DEFINITIONS AND SELECTION

A. Key Areas

A key area is one where deer or other big game have demonstrated a definite pattern of use during normal climatic conditions over a long period. Because of its location, value, and use, the key area serves as an indicator of general range conditions and population levels and is sensitive to changes in management.

Interagency personnel are responsible for large range areas which, of necessity, precludes gathering intensive data on more than representative portions of the total. Therefore, monitoring must be conducted on those limited areas that, when properly used, assure maintenance of satisfactory conditions on the range as a whole.

Selected key areas, on which measurements will be made, should be delineated on a range map and identified as a permanent record. Such records would be maintained in permanent files for reference, particularly for the benefit of new interagency personnel.

Guides to be followed in selecting key areas are:

- (1) They must be located on range obviously used by game animals and representative of a season-long unit.
- (2) Key areas will first reflect results of management. For example, on winter browse ranges, ridgetops and south-facing slopes frequently will receive heavy use before other areas. These sites would often, but not always, be the key to management. One cannot separate area and species used in management, but must rely upon an accumulating series of data on total forage resource use at a local site for delineating key areas. There is no substitute for continual on-the-ground observation of use patterns throughout the season for this purpose.
- (3) Key area assessments should not be conducted on small acreages of unavoidably excessive use, such as natural salt licks, small cover patches, or small slopes where game tend to concentrate in exceptional densities.
- (4) Widespread adoption of rest-rotation or other grazing systems may require designing key area monitoring to fit the livestock use pattern. A comparison of game use on rested and livestock-grazed units may yield useful data elucidating the degree of current-year competition between domestic and wild ungulates. Grazed units currently receiving heavy livestock use may shift game to rested areas. Establishment of rest-rotation pastures perpendicular to big game winter ranges rather than along elevational zones could mean the difference between moderate and severe impacts on game, respectively.
- (5) Key areas may need to account for differing climatic conditions. Mild open winters shift use patterns considerably and a dual system of key areas delineating open winter vs. normal or severe winter zones is desirable.

B. Key Plant Species

Key species should serve as indicators of change that may occur in the vegetative complex causing adverse watershed conditions and reduced game carrying capacity if they are over-used. Conversely, and equally important, the key species should indicate that game populations are below carrying capacity if their utilization is at less than acceptable sustainable levels. There is a tendency to view lightly or moderately used browse plants as "good conditions" after use is completed. Such a view is not fully warranted as a general rule, at least not on a long-term basis.

There are seven general criteria that a selected species should reasonably satisfy. Gross departures from these criteria have led to poor choices of key species in the past. Increased care in the selection procedure, more than any other factor, can determine effectiveness of the browse utilization transect in providing the necessarily sensitive index to balance or imbalance of game numbers to carrying capacity.

The seven criteria in the selection of a key species are:

- (1) high relative palatability but not an "ice-cream" plant,
- (2) reasonably resistant to grazing pressure,
- (3) resistant to competition from other species,
- (4) sufficiently abundant to be an important component of the community,
- (5) nutritious,
- (6) produces a considerable volume of available forage, and
- (7) pattern of use is gradual and continuous throughout the grazing period. Selection of the browse species on which to key management is an important first step in game herd management. It is a

continuing process of modification as more information is gathered. Data on more than one species are frequently required to adequately reflect use of the total resource. The Utah Big Game Range Inventories (DWR) are useful guides for selecting key species since they provide quantitative data at the local level. Forest Service and Bureau of Land Management range inventories likewise should be helpful.

Species that satisfy the criteria in one area may not be suitable in another depending upon their relative importance in community composition, forage production, season of use, elevation, and climatic conditions. A basic assumption of the concept is that when the key species is (are) properly used, other less important, usually less palatable, species will not be over-used.

STUDY DOCUMENTATION

Since trend monitoring will be an intensive type study and will involve the use of permanently marked transects and plots, there will be a need for accurate documentation of each study site. This means that a permanent file should be prepared and maintained for each site. The first and perhaps most basic information to go into such a file will be instructions, etc., on how to locate the site and each plot or transect. For this purpose, a study location form (attached) and an appropriately marked map or aerial photo should suffice.

NESTED TREND STUDY LOCATION

Deer Herd Unit _____ Study Site Name _____ Trend Study # _____

Range Type _____ Date _____ Name(s) _____

Narrative (see back of form):

Compass bearings: baseline _____, density plots _____ # belts _____ # density
plots _____ distance between density plots _____ belt length _____ baseline
footmarks for belts _____ Footmark for 1st frame _____
interval between frames _____ # frames/belt _____ plot sizes:
grasses & forbs _____, shrubs & trees _____ Type of plot markers _____
_____ Aerial photo or map designation _____

Diagram (see back of form):

Narrative Suggestions

1. Record mileage(s) from permanent landmarks, town, intersections etc. to a point in the immediate vicinity of the study where an identifiable landmark or "witness marker" is located. From this point the observer(s) will need instructions for foot travel.
2. Record the azimuth or bearing from the witness marker to the start point of the nested frequency baseline or to various recognizeable intermediate points. True or Grid bearings are recommended.
3. Measure and record the distance, either taped or paced, to the aforementioned point(s).
4. Include instructions on how to locate the density plot centers from the frequency plot baseline.
5. Include any other descriptive information that will help locate and document the study. Remember that there can scarcely be too much detail.

Diagram Suggestions

1. Show all roads, trails, streams, landmarks etc. in their proper relation to each other. An approximate scale drawing as to bearing and distance should be made. This is especially important for the area close to the study. Most of the diagram space should be used for this area. The road mileage etc. from towns etc. to the witness mark is less critical.
2. Indicate cardinal directions.
3. Show all distances and bearings used on the route to study.
4. Indicate the spatial relationship or arrangement of the nested frequency and density portions of the study.

REREADING TREND STUDIES

At least initially, trend studies should be scheduled for rereading on a 5- to 7-year rotation. This of course, is not a rule; it is merely an estimate. As trend studies are implemented on various sites around the state, we will probably find that the time required for detectable vegetational or soil condition changes to occur will vary. Experience and the need for trend data will likely be the controlling factors.

U. S. FOREST SERVICE
NESTED FREQUENCY PROCEDURE

The nested frequency part of the trend study method is adapted directly from U. S. Forest Service methodology. It is designed to provide detailed information on plant composition and ground cover. A minimum of two observers are necessary to conduct the study. The following procedure is taken from the Region 4 range analysis handbook.

RANGE ANALYSIS HANDBOOK

*- 4.63 - Nested Frequency/Shrub Density Method.

4.63a - Nested Frequency Technique. Frequency is defined as the number of times a species occurs in a given number of plots and considers only species presence or absence. It is a rapid, objective means of collecting data for evaluating trend.

The nested frequency concept involves sampling of the vegetation with various sized plots nested within a frame. Samples are taken along randomly selected transect lines confined to a single habitat type. The data collected is a function of plot size, which in turn is related to density, distribution, and size of the vegetation. These data serve as a basis for determining trend and can be evaluated by applying statistical procedures and computer technology.

The nested frequency procedure has several important advantages over other trend study methods: (1) It is highly objective, (2) relatively easy to perform, (3) repeatable, (4) significantly more reliable than previously used methods, and (5) allows for continuity in noting vegetative changes through the use of nested plots.

Presently the nested frequency sampling method provides information on changes in vegetal composition and ground cover exclusively. Site specific score cards are needed before range condition ratings can be assigned.

4.63b - Selecting the Study Site. Frequency sampling, as with any other trend study methods, should be confined to a single habitat type. Section 4.11 should be used as a guide in selecting and screening benchmark locations. Prior to superimposing the nested frequency technique on some other type of trend study, it should first be determined that the existing transect meets the requirements for an acceptable trend study. If there are problems which cannot be corrected, a new site should be selected.

4.63c - Location Description. Upon selecting the study site and/or finding the previously established benchmark, the location should be documented and any changes in reference points or status of the transect noted. This information is recorded on the back of the Nested Frequency Data Sheet, R4-2200-22 (7/82), exhibit 1.

-*

RANGE ANALYSIS HANDBOOK

Exhibit 1

NESTED FREQUENCY DATA

Forest Bridger-Teton District Big Piney Allotment Sherman Date 8/28/81
 Study Name and/or Number Horse Pasture Draw B-25 Bell Number 1-11
 Vegetative (Habitat) Type ARTRV/FEID Conducted by Training Group

Vegetative (habitat) type		Sample Number																				Plot Freq.			No. Occur	% Comp	Desirab. Rating	Allowable Occur.		
Species		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	D	I	L						
Grasses	FEID	1	2	1	1	1	4	1	1	1	1	4	1	1	1	1	4	1	1	1	4	75	80	100	16					
	SILE	3	1			2		4	2	1	3	4	1	1	1			3		4		20	30	45	60	9				
	AGTR		1		4			2	3		4		3		4	3		4		3	5	10	30	50		6				
	KOCR						2				3				2						0	10	15	15		3				
	POAM		3						2						3			4			0	5	15	20		3				
Forbs	JURA	4		1		3	4		2					3		1	4		3	4	10	15	30	50		6				
	CAFI	3	2			2		1	4		3				4			4		2	5	20	35	60		7				
	POGR	3	4	3	2		3			4	3	4	4	4	3	3		4	3		0	10	45	70		9				
	ERHE2	1	4			3		1	4		3			4	1		3	4	1	4	20	20	40	65		8				
	ASCHA	4	1		1		4	1	2	4	1		1		1	2	4	1	4	1	40	50	80			10				
Shrubs	ACHIL	4	3	2	4		4		1	4	3			4		4		4		4	5	10	25	65		5				
	GEVI	3		2		4	3	4	2	2	4	2				4	3		3	4	0	20	45	70		9				
	LUSE			1						3			2	1				3			10	15	25	35		5				
	ARCO2					2									4	1					5	10	10	15		2				
	ARHO		2							4											0	10	10	15		2				
	FRVE								1									2			5	5	5	5		1				
	ARLU											2									0	5	5	5		1				
	ARTRV					3		4											4		0	0	5	15		1				
Plot yielding best frequencies (Plot size to be summarized)																														
Ground Cov.	Veg.	Lil.	Rock	Pave	Moss	Soil	Total																		Totals					
Dot Tally	23	17	2			8	80																		103					
Totals	23	17	2			8	80																		99.5					
Other Species: ASLE2 is the best plot for this site. Desirability Rating based on 1969 score card.																														
56 45 2																														

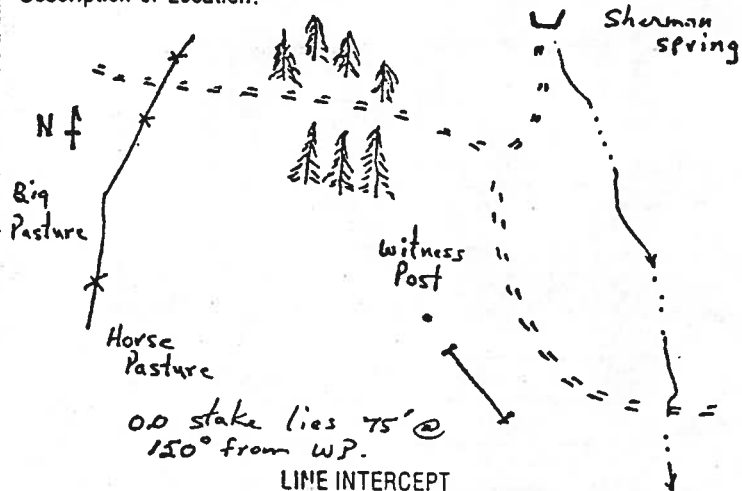
Other Species: ASLE2 VTPR
 Plot #3 is the best plot for this site.
 Desirability Rating based on 1969 score card.

RA 2200 22 (1/82)

RANGE ANALYSIS HANDBOOK

Exhibit 1 (cont.)

Description of Location:



LINE INTERCEPT

Species	ARTRV	ARCA			
Inches of Intercept	15	10			
	8	7			
	22				
	6				
	13				
TOTAL	64	17			

SHRUB DENSITY

Species		ARCA				ARTRV			
Age Class	Seedling Sprout	S		3					
	Young Sapling	Y	3						
	Mature	M	4	4					
	Decadent	D							
	Dead	X							
Form Class	All Available	Lightly Hedged	U	U					
			7	7					
		Moder Hedged							
	Largely Avail.	Closely Hedged							
		Lightly Hedged							
		Moder Hedged							
	Closely Hedged								
	Mostly Unavailable								
	Unavailable								

BROWSE TREND CHARACTERISTICS RATING

Upward Trend	No Apparent Trend	Downward Trend
D and I browse plants healthy, vigorous, and have good color for the site. ☒ Reproduction of browse species high, all age classes represented. The percent of seedlings and young plants exceed those of decadent and dying plants by more than 5 percent. ☒ Young plants not being pulled up, trampled out, or otherwise destroyed by use of the area. ☒ Crown of D and I browse species normal, loose, and open growing ☒ Two or more year's production of vigorous and healthy regrowth following the heavy seeding of D and I. ☒	D and I species exhibit good health but may have reduced vigor and poor color for the site. ☐ Moderate amounts of reproduction of D and I species. Seedlings and young age classes of the better browse equal to but do not exceed the number of decadent and dying plants. ☒ D browse plants not being trampled out, pulled up, or otherwise destroyed by use of the area. ☐ Crowns of D and I browse plants showing moderate hedging. ☐ Few dead branches or plants of D or I species. ☐	D and I species unhealthy, lack good color and exhibit lack of vigor for the site. ☐ Reproduction of D and I species lacking or nonexistent. Number of old and decadent plants of preferred and staple species exceed seedlings or younger age classes by more than 5 percent. ☐ Young browse plants being pulled up, trampled out, or otherwise destroyed by use of the area. ☐ Crowns of least desirable browse plants compact and exhibit heavy hedging ☐ Regrowth lacking following heavy hedging. Annual growth of twigs short and few in number. ☐ Many decadent plants and plants with 50 percent of the branches dead. ☐

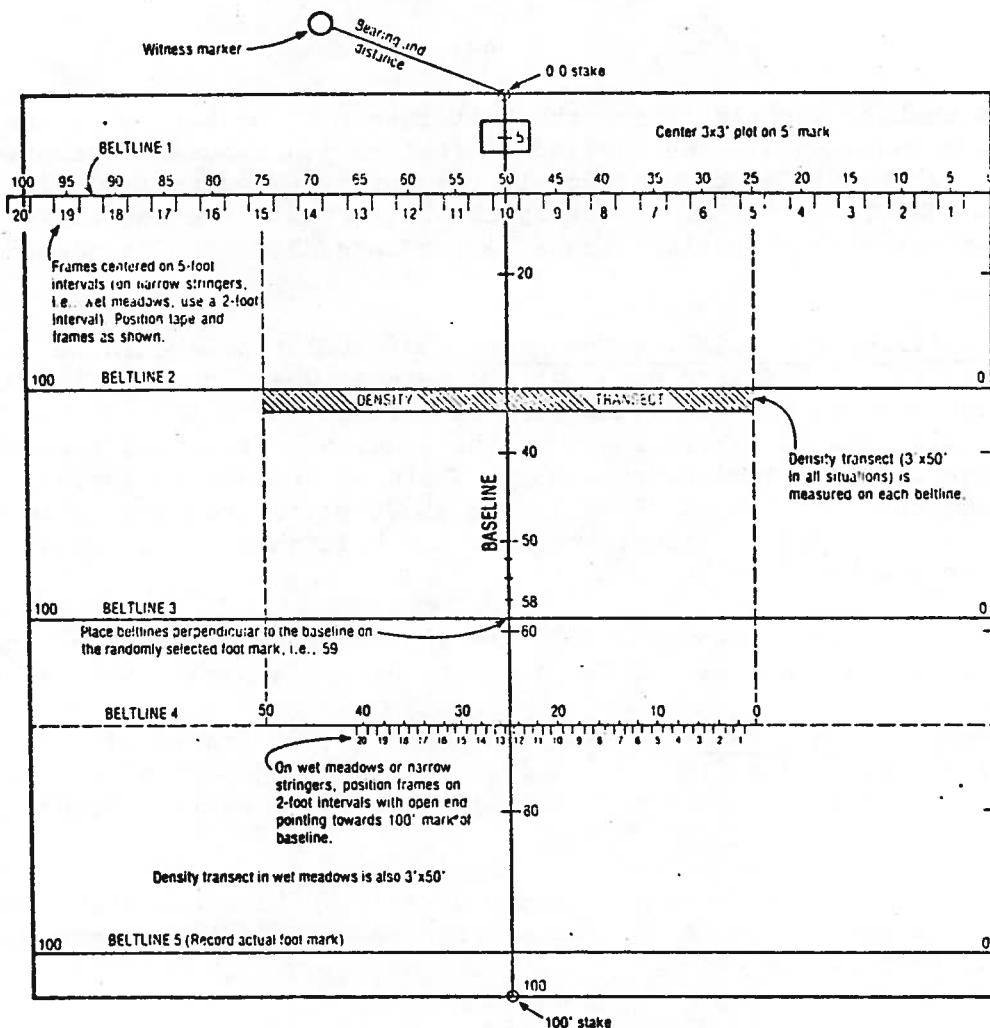
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- *- 4.63d - Setting Up the Baseline. The baseline is defined as the permanent reference part of the study. Setting up the baseline for this technique is similar to that of the Parker 3-Step procedure (4.62a) except that the precise location and placement of the tape and stakes is not critical. The 100' tape is stretched along the previously established or newly selected transect line assuring the 0.0 stake corresponds reasonably well with the 0' mark on the tape (see exhibit 1). If it is a new study, an 18-24" piece of reinforcing rod can be used in place of angle iron stakes. After establishing the baseline, proceed to lay out the 3'x3' plot as described in section 4.62a item 4.

Exhibit 1

NESTED FREQUENCY - SHRUB DENSITY MACROPLOT LAYOUT

Baseline - Permanently established
Beltline - Randomly selected (record foot mark)



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- *- 4.63e - Photographs. Photos are an important part of the study and should portray changes taking place on the ground. They should provide a good visual image of the site and help to relocate the study for future measurements.

As a minimum, a general view and a closeup photo of the 3'x3' plot should be taken on the baseline before taking any measurements. Both photos should be taken from the 0.0 baseline stake; any additional photos may be taken if desired. Section 4.61b provides specific guidelines for taking photographs.

4.63f - Location of the Beltlines. The beltline is defined as the randomly selected tape line along which the data are collected. A minimum of five beltlines will be established perpendicular to the baseline. Location of the beltlines in relation to the baseline has been predetermined using a stratified random sample technique. One beltline will be established at each of the following foot marks on the baseline:

<u>Belt</u>	<u>Foot Mark</u>
Belt #1	11
Belt #2	34
Belt #3	59
Belt #4	71
Belt #5	95

These five numbers identify where the beltlines will be set up during current and future measurements. The assigned belt location should be recorded on the data form, exhibit 1, section 4.63c, in the following manner: 1-11, 2-34, 3-59, etc. The first number indicates the belt, while the second denotes the randomly selected beltline locations. A separate data form is needed for each beltline.

4.63g - Setting up the Beltline Transect. The 100' tape should be stretched at right angles to the baseline with the 50' mark of the tape positioned over the selected footmark of the baseline. The only requirement is that the beltline be essentially at a 90 degree angle to the baseline, stretched reasonably tight and as close to the ground as possible. There is no need to install permanent stakes along the beltlines as long as the above procedures are followed. Exhibit 1, section 4.63d, illustrates how the beltlines are arranged in reference to the baseline.

In sampling long narrow types, a 50' tape should be used; however, the 100' tape may be used as long as samples are confined to a single habitat type.

4.63h - Number of Samples (Frames). A minimum of 100 frames will be sampled at each study site. Twenty frames will be measured along each of the beltlines and should be positioned in the manner illustrated in exhibit 1, section 4.63d.

Where the vegetation is found to be very diverse in kind and distribution of species, a greater number of samples may be needed. In these instances, additional belts can be established.

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49
48
447
441K
-1

- *- 4.631 - Frequency Frame/Nested Plot Size. The frame is defined as the sampling tool. The nested plot(s) refers to the size of the sampling units contained (nested) within the frame. For the purpose of this methodology, sampling with successive nested plots can be defined as:

Sampling of the vegetation with four plots of different sizes where the smaller plots are contained (nested) within a larger plot.

Plot sizes contained within the standard sized frame are as follows:

~~50 x 50cm-----approximately 20x20"~~
~~25 x 50cm (inside dimensions)-----9.84x20"~~
~~25 x 25cm plot inside dimensions-----9.84x9.84"~~
~~5 x 5cm plot inside dimensions-----1.96x1.96"~~

35.4 x 35.4
25 x 25
11 x 11
5 x 5

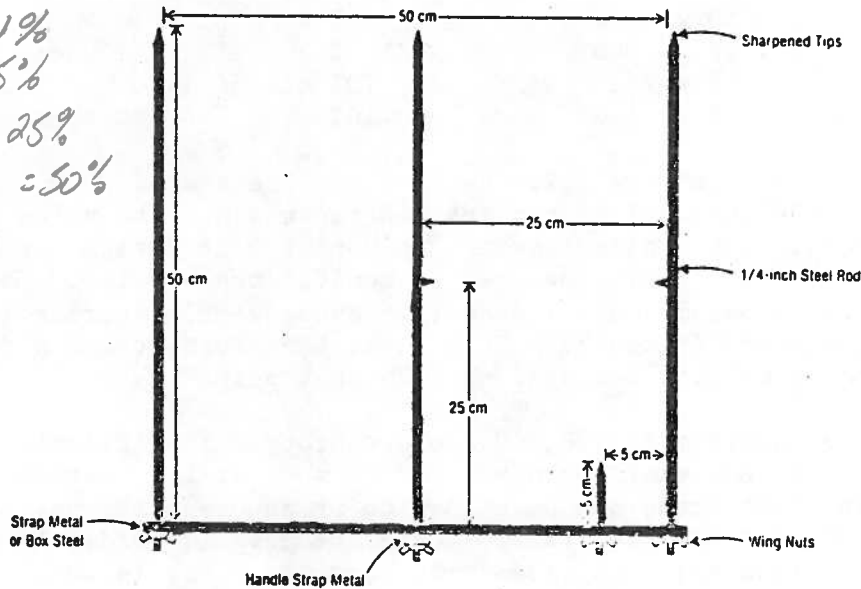
Exhibit 1 illustrates the Frequency Frame (collapsible).

Exhibit 1

NESTED FREQUENCY FRAME (Collapsible)

CLASS NESTING

- 1 5cm x 5cm = 1%
 2 11cm x 11cm = 5%
 3 25cm x 25cm = 25%
 4 35.4cm x 35.4cm = 50%



1. All dimensions are inside measurements.

2. Materials:

- 1/4-inch steel rod: Threaded so that proper dimensions are obtained when tightened. Sharpened at the tips.
- 1/8 to 1/4-inch strap metal and/or 1/4 to 3/4 inch box steel for back plate and handle.
- Wing Nuts: Used to remove the slack out of the rod when threaded in place.

NOTE: The handle is not absolutely necessary, however it does help in lining up the frame with the tape.

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- *- In very sparse vegetation, i.e., in very poor sites or in desert types, a larger plot may be needed in order to monitor the vegetation. In these situations, the optional frame would be used to collect the data.

Most sites contain grasses, forbs, and shrubs mixed in the composition. Selecting the plot size for sampling mixed communities would present a real dilemma without the benefit of successive nested plots. By using nested plots, data from four-sized plots is collected and evaluated for preferred frequency values.

The largest plot contained within the frame will quite often yield high frequencies in densely vegetated areas whereas the smallest plot will yield low frequencies or may even miss certain species. Ideally, the best frequencies (20-80 percent) for most species should occur in one of the medium-sized plots. However, if the best frequencies occur in either of the other plots, the data are still valid. The data will indicate the size of plot best suited to monitor the vegetation. All comparisons must be based on a single plot size; however, if the frequency values change substantially, it may be necessary to select a different plot size for future comparisons.

The following example serves to illustrate this concept:

<u>Plot Size</u>	<u>Frequency Obtained</u>
50 x 50cm	100%
25 x 50cm	100%
25 x 25cm	70%
5 x 5cm	10%

In this example, the data collected reveals the nested 25 x 25cm plot yielded frequencies (70 percent) in the desired range since the value fell between 20-80 percent. Data collected with this plot size during a subsequent measurement would normally be used to monitor the species. However, if the species were to become more abundant, a subsequent measurement might produce higher frequencies in the 25 x 25cm plot; therefore, the 5 x 5cm plot might be best suited to monitor the species from that point on.

In this example, if the frequency values dropped significantly in the 25 x 25cm plot, the 25 x 50cm plot could be used to monitor the species. It should be kept in mind that trend can be either up or down and the use of nested plots offers the opportunity to monitor these changes. In order to do this, data must be collected from all plot sizes each time the study is measured.

4.63j - Numerical Identification of Nested Plots. Since data will be collected from all four plots within the frequency frame, the individual plots within the frame need to be easily identifiable. For the sake of uniformity in recording of data, exhibit 1 numerically identifies the nested plots within the frame.

The concept of nested plots can be best described as follows: If a certain species were encountered in plot No. 1, it is automatically contained within

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*- plots No. 2, 3, 4. If a species were found in plot No. 2, it is also in the larger plots (plot No. 3 and 4), but it is not within plot No. 1.

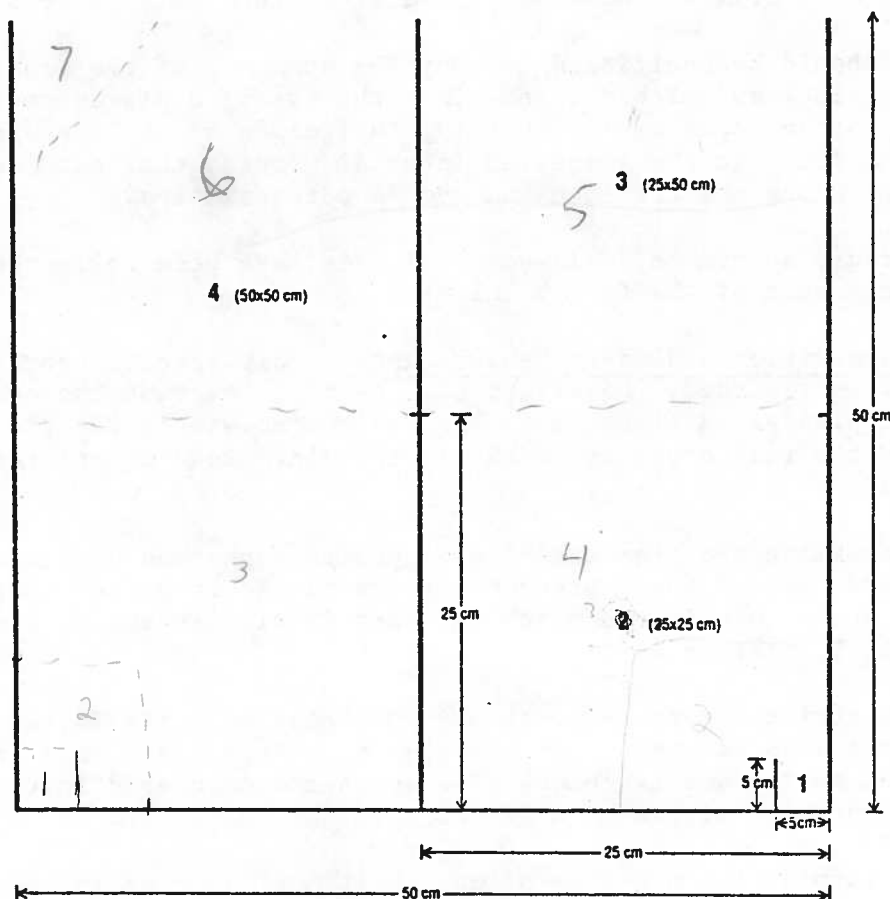
The number five will be used to designate the 75 centimeter plot; however, data will only be collected from the four largest plots. The numerical designation corresponding to plot sizes should be entered on the form under the heading plot frequency.

This numerical designation will facilitate recordkeeping according to the various plot sizes.

Exhibit 1

NESTED FREQUENCY FRAME

Numerical Designations
and Plot Sizes



Numerical Designation

Optional Frame: 100x100 cm

w/nested 50x50 cm plot

25x50 cm plot

25x25 cm plot

5

4

3

2

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- *- 4.63k - Collapsible Nested Frequency Frame. Since part of the sampling will be done in remote locations, the examiner should be able to carry the needed equipment with relative ease. The basic design for a lightweight collapsible sampling frame is illustrated in exhibit 1, section 4.63i. Generally, heavier materials are recommended for construction of rigid frames.

In the event the collapsible frame is to be carried horseback, a leather or canvas pouch could be constructed. Care should be taken to prevent the prongs of the frame from being bent. If this occurs, they should be straightened out and/or replaced. A change in dimensions could result in a change in frequencies thereby invalidating the collected data.

4.63l - Reading and Recording Data.

1. Placement of the Frame. Once the beltline has been set up, the frame should be placed at regular intervals along the beltline as illustrated in exhibit 1, section 4.63d. Frames should be placed at 5' intervals along the 100' tape except when sampling narrow stringers; i.e., wet meadows. In these situations, the frames should be placed at 2' intervals along a 50' tape.

The frame should be positioned so that the open end of the frame is pointed towards the 100' end of the tape. Once the frame is placed on the footmark, it should not be moved during sampling to include or exclude species. Placing the frame at the specified interval assures that samples are well distributed along the beltline and avoids personal bias.

This procedure should be followed until data have been collected from twenty frames along each of the five beltlines.

2. Composition and Cover Measurements. Only species rooted within the the frame will be recorded. No effort will be made to count the number of individual plants. A plant is considered rooted within the plot/frame if any portion of the root crown is contained therein. Reading and recording will be as follows:

a. Determine the presence of all species contained within the smallest nested plot. Record their presence on the Nested Frequency Data form by placing a number one in the block for that particular sample along the belt, see exhibit 1, section 4.63c.

b. Determine the presence of any additional species in the next larger plot. Enter a number two for these species. Record a 2 only for species not encountered in the smaller plot. The species encountered in the smaller plot are also contained within each larger plot.

c. Determine the presence of any additional species in the third largest plot. Enter a number three for those additional species encountered. Only species not encountered in the two smaller plots are recorded as a three.

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*- d. Record the presence of any other species in the largest plot; place a No. 4 only if additional species are encountered. Where the 100 x 100cm plot is used, a number five would be used to record the presence of species in this plot size.

e. Record cover and bare soil data by noting the type of ground cover component present at the four pointed prongs of the frame.

The tips of the prongs should be sharpened to obtain discrete measurements. Actual measurements are made at the point where individual tips come to rest on the ground. The prongs should be pressed against the ground and an observation made of the ground cover characteristic directly under each tip.

For each placement of the frame, four separate cover measurements will be dot tallied. Cover hits will be recorded in the following categories:

Vegetation	Rock (greater than 3/4" diameter)
Bare Soil (Soil particles <1/8" dia.)	Litter
Pavement (1/8" to 3/4")	Cryptogams (moss, lichens)

f. The field portion of the data form should be completed before proceeding to the next beltline. This includes computing frequency for each plot, summarizing ground cover, identifying a key species if possible, and listing species missed in sampling. Shrub density data should be obtained as described in section 4.63n.

3. Computation of Frequency. Frequency is defined as the ratio of times the species occurs in a particular sized plot to the number of possible occurrences. Percent Frequency will be computed for all species sampled as described in the following example with Agropyron trachycaulum:

<u>Nested Plot Sizes</u>		<u>Plot Number</u>
	50 x 50cm	4
Frame	25 x 50cm	3
50 x 50 cm	25 x 25cm	2
	5 x 5cm	1

Frame	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
AGTR	4	2	3	1	3		3	4	3	3	4	3	4	3	3	2	4	4	3	2

Percent Frequency of AGTR: Plot Size No. 1 = $\frac{1 (\text{No. of occurrences})}{20 (\text{No. of samples})} \times 100 = 5\%$ frequency

In this example, AGTR occurred only one time in plot size No. 1.

To compute frequency on plot No. 2, count all the No. 1's and No. 2's and again divide by the number of frames per belt.

$$\text{Plot Size No. 2} = \frac{4}{20} \times 100 = 20\% \text{ frequency}$$

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*- To compute frequency for plot size No. 3, count all the 1's, 2's, and 3's; since the occurrences in plot size 1 and 2 are also contained within plot No. 3. The total number of occurrences are then divided by the number of frames to obtain the percent frequency for plot #3.

$$\text{Plot Size No. 3} = \frac{13}{20} \times 100 = 65\% \text{ frequency}$$

$$\text{Plot Size No. 4} = \frac{19}{20} \times 100 = 95\% \text{ frequency}$$

4. Species Found But Not Encountered in Plots. Any species not encountered in the individual plots but found growing along the beltline should be listed at the bottom of the data sheet. These species, although not very abundant, may be indicative of the management emphasis needed.

4.63m - Selecting the Plot Size to be Summarized. The above example indicates that plot No. 3 yielded the best frequency for AGTR since it fell closer to the midrange of the desired frequencies. Data collected with plots 1, 2 and 4 were on the fringe or outside of the preferred range of 20-80 percent frequency. Plots 1 and 2 were too small while plot No. 4 was too large to effectively monitor the species. Although individual species can be monitored in this fashion, a given plot size may not be the best for monitoring all species. The objective should be to select the one which does the best job of monitoring the majority of the plant species.

The frequencies obtained for a particular species should be reasonably consistent on all five beltlines and the best plot size for the vegetative community should be the same on all beltlines. When different beltlines indicate a different plot size is needed to monitor the vegetation, one or more of the following situations may exist.

1. Beltlines or portions of a beltline are not within the same habitat type.
2. Data were erroneously recorded.
3. Frequency was computed erroneously.
4. Taxonomically similar species may have been misidentified between beltlines.

4.63n - Shrub Density Technique. Although shrub density data have not been previously used in Region 4 as a means of monitoring trend, it can be used to supplement data collected with the Nested Frequency method. It should not be employed as the sole basis for determining trend but may be used in lieu of the line intercept procedure. The technique provides shrub species density along with information on the form and age class of the various shrubs present. This

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- *- information provides additional data for evaluating condition and/or trend in the shrub community.

Shrub density and/or line intercept data (discussed in a later section) should always be collected when shrubs are present in the vegetative community. This data is especially important where some form of cultural treatment has been done and/or where the shrub component is important for wildlife.

4.63o - Density Measurements and Recording. Measurements are taken along a 50' segment of each beltline by using a 3' stick held perpendicular to the beltline tape. This creates a sample area 50' long and 3' wide. Exhibit 1, section 4.63d, shows how the belt transect should be laid out in connection with the Nested Frequency beltline. The technique can also be used in a similar fashion along each transect of a Parker 3-Step cluster.

All shrubs encountered along the belt transect are dot tallied by species and classified according to form and age class. The reverse side of the Nested Frequency Data Form (exhibit 1, section 4.63c) is used to record this information.

a. Age Classes. To assure consistency in classifying and recording shrubs by form and age class, the following definitions should be used:

Seedling (S) - A very young plant which has become firmly established yet obviously is a newcomer on the site (first year seedlings are ignored). It is usually distinguished by its relatively small size, generally single stem, simple or no branching, succulent bark, less than 1/8" diameter at the base, and does not possess a large root stock (sprouts may be an exception). No evidence of flowering or seed production.

6-8 leaves

Young (Y) (Sapling) - A relatively young plant, larger than a sprout or seedling (1/8" to 1/2" diameter at the base, varying with species) with more complex branching, may possess multiple basal stems but are attached to a relatively small root stock (except for saplings), bark is more fibrous but is not fissured as with a mature plant. Crowns are not rounded and are made up of all living wood. May or may not show signs of flowering and seed production.

Mature (M) - A mature plant exhibits complex branching and multiple stems, fibrous fissured bark, rounded growth form, large, heavy, often gnarled stems and a firmly established predominant root stock. The root crown is made up of three-quarters or more living wood. Evidence of flowering and or seed production is present.

Decadent (D) - A mature plant which possesses more than 50 percent dead wood in the crown.

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- *- Dead (X) - A plant which obviously does not possess any live crown, but the root is still firmly attached (downed, unattached, woody stems are considered litter).

b. Form Classes. The form classes are based on availability of browse plants and their degree of hedging. These factors along with age structure can assist in determining the relative health of a browse stand and can aid in evaluating trend.

Availability represents the relative amount of twig growth which is within reach of grazing animals. Snow depth or duration will have no bearing on availability, as defined in this Handbook. Hedging is the result of repeated utilization and is one of the factors which affects availability of shrubs. The general appearance of the plant is a primary criteria in determining degree of hedging.

The following descriptions are provided as an aid to classifying shrub availability.

All available - This category signifies that all of the current years twig growth is within reach of grazing animals. This type of plant is generally represented by an open crown.

Largely available - The bulk of the vegetation in this category is available to the class of herbivores present in the area. A few shrubs are unavailable due to:

1. Large crowns.
2. Moderate to heavy hedging.
3. Shrubs height.
4. Steep terrain.
5. Stand density.

Mostly unavailable - A large portion of current years growth is not available for grazing. This may be due to one or more of the reasons mentioned in the largely available category above.

Unavailable - These shrubs may produce large quantities of twig growth; however, it is not available to grazing animals. Frequently, a tall growth form places shrubs in this category. A hedgeline is also common where shrubs have become unavailable. Dead or decadent plants often fall in this category.

Hedging categories are described as follows:

Lightly hedged - Shrubs of this nature generally have open, loose crowns and produce a large quantity of vigorous twigs. Frequently, these plants are either all or largely available. Their appearance is that of healthy, fast-growing plants.

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*Σ nested freq.
quadrat freq.
cover*

- *- Moderately hedged - These shrubs possess moderately open crowns but show signs of some clubbing. Plants which are hedged to this degree exhibit varying levels of vigor and begin to take on a ragged appearance. Some of the twigs are readily available while the remaining twig growth is generally unavailable due to the tight growth form and presence of larger clubbed stems on the periphery of the crown.

Closely hedged - A closed, compact rounded appearance is usually characteristic of this degree of hedging on a mature plant. Generally, very little twig growth is present on the exterior portion of the shrub; most of the twig growth is confined to the interior.

A decadent plant often shows signs of close hedging on the few larger stems which produce limited leader growth. Young plants are generally not very common in a closely hedged shrub community.

4.63p - Summarization of Data. Data collected from all of the beltlines should be summarized on the Nested Frequency Summary worksheet. Only data from the best plot size will be summarized. Summarization and subsequent evaluation will be based solely on the number of occurrences obtained from each beltline. The following is an explanation of how the data should be summarized and organized in preparation for statistical evaluation.

1. Nested Frequency Data Summary. The data collected from the selected plot size should be summarized for each beltline as follows:

a. Number of Occurrences. Once the best plot size for the vegetative community is selected, the number of occurrences should be calculated. The number of occurrences is merely the number of times the species occurred in the selected plot size. This can easily be computed by either counting the number of occurrences; i.e., 10 out of 20 equals 10 occurrences; or if a 30 percent frequency is obtained, the number of occurrences can be computed as follows:

$$\text{Number of occurrences} = 20 \text{ frames} \times 30 \text{ percent frequency} = 6$$

b. Percent Composition. Compute the percent composition for each of the species listed. This is done by dividing the total number of occurrences for each species by the total number of occurrences of all species in the beltline. The sum of these individual values should total 100 (+ or -1) percent.

c. Desirability Rating. Enter the desirability rating for each of the species encountered. Use the species list contained in exhibit 5 or 6, section 2.4ld. In order to make valid comparisons, all data from each year's measurement must be classified according to the proper desirability.

d. Allowable Occurrences. Determine the allowable occurrences for each species as to D, I, and L. The explanations in the proceeding example make reference to exhibit 1, section 4.63e.

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*- A species such as Eestuca idahoensis (FEID) with a desirability of D-30 would be classified as desirable up to 30 percent of the composition. The balance if any, would be classified as intermediate. Since FEID makes up 15.5 percent of the composition, all of the occurrences would be listed as desirable (D). Geranium viscosissimum is classified as D-5, I-6-25, L-26+; could be rated in all three categories if its percent composition were greater than 25. In exhibit 1, section 4.63c, Geranium viscosissimum is listed as having 9 occurrences and 8.7 percent composition. To determine the number of occurrences to be classed as desirable, multiply 5 percent (.05) times the total number of occurrences (103). This calculation gives a value of 5.15 which is rounded off to 5 occurrences. These 5 occurrences are entered in the desirable (D) column. The remaining 3.55 units of the composition ($8.7 - 5.15 = 3.55$) is then multiplied by 103 to arrive at the 4 (3.66 rounded off) occurrences which are entered in the intermediate (I) column. In this case, there are no further entries since GEVI only makes up 8.7 percent of the composition. The final step in summarizing allowable occurrences is to obtain totals for D, I, and L.

e. Ground Cover. Total up the number of hits on all ground cover components. The total of these should equal 80 on each beltline.

2. Shrub Density Data Summary. Shrub density data are summarized concurrently with the frequency data. The summary is merely a total of the dot tallies recorded for each individual species on each belt transect. These totals can subsequently be compared with previous or subsequent measurements of the same stand.

4.63q - Apparent Trend Rating. After collecting and summarizing both nested frequency and shrub density data, the Apparent Trend Form (exhibit 1, section 2.23f) should be completed. Where shrubs are present, the Browse Trend Characteristic Rating on the back side of the Frequency Data Form (exhibit 1, section 4.63c) should also be completed before leaving the study site. It should be recognized that apparent trend indicators are basically use oriented and may not correlate with the trend of ecological condition. The apparent trend rating should not be confused with long-term trend which is obtained by comparison of repeated measurements made over time. This rating merely serves to highlight what appears to be taking place within the community as it relates to the management objectives for the area.

4.63r - Evaluation of Data. The summarized data from each beltline should be transferred to the Nested Frequency/Shrub Density Summary, R4-2200-23 (8/82), (exhibit 1) and evaluated using Analysis of Variance to determine if the change between measurements is significant. At least two readings are needed in order to use this statistical evaluation.

Although many different comparisons can be made, as a minimum, the following parameters should be evaluated in connection with each study: (1) changes in plant composition as expressed by the occurrences in the three desirability groups, i.e., desirables, intermediates, and least desirables; and (2) changes in bare soil; and (3) changes in one or more key species. If the trend study is located on an important winter deer range, it might be very important to know whether there are significant changes taking place in the number and/or

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*- age class of a particular browse species. This information could be obtained from the shrub density measurements.

1. Analysis of Variance Test. The Analysis of Variance Test can easily be performed manually using a programable calculator or the data can be evaluated with the use of the computer. At least two readings are necessary to perform this test.

The objective is to determine if (1) there are significant differences between means and (2) if more than 2 years data are available, establish the basis for performing the least significant differences (LSD) test.

A table displaying the degree of freedom (df), sum of squares (SS), mean square (MS), calculated "f" and tabular "f" values should be generated for all sources of variation.

<u>Source</u>	<u>df</u>	<u>SS</u>	<u>MS</u>	<u>calculated "f"</u>	<u>tabular "f"</u>
Years (y)	-	-	-	-	-
Belts	-	-	-	-	-
Error	-	-	-	-	-
Total	-	-	-	-	-

After these figures are computed, the calculated "f" and tabular "f" values can be compared to determine if there is a need to proceed with further testing of the various means. When the calculated "f" exceeds the tabular "f" value, a significant difference does exist and the test for Least Significant Difference (LSD) may be performed where more than 2 years of data are being evaluated.

The LSD test is used to determine which of the years and/or belts are significantly different. If a significant difference is found between any of the belts, it may be attributed to one or more of the following:

- a. The study is not located in a uniform habitat type.
- b. There is too much variation within the habitat type and five beltlines cannot adequately sample the site.
- c. Errors were made in collecting or summarizing the data.
- d. The site may have had some form of local disturbance.

Where any beltlines are found to be significantly different, effort should be made to confirm the reason(s) for these differences. If these differences persist on the same belts during subsequent readings, it would indicate that the differences are due to factors other than sampling error. In this situation, only those belts which are not significantly different should be utilized to assess changes in the yearly means.

Where yearly means are found to be significantly different, it is also possible they are due to sampling error. Sampling errors may include: *

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- *- a. Improper recording of data.
- b. Assignment of wrong desirability ratings.
- c. Misidentification of species (i.e., FEID and STLE or DECA).

After any obvious sampling errors are corrected, any remaining differences can be attributed to real changes in the environment.

The procedure for manually performing this test is as follows using the allowable occurrence data on desirables contained in exhibit 1, section 4.63r, and on exhibit 1 in this section.

<u>Desirables</u>	<u>Beltline</u>					<u>Totals</u>	<u>Mean (x)</u>
	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>		
Year 1 <u>1964*</u>	44(1)	44	43	46	42	219(5)	43.8
Year 2 <u>1970*</u>	48	47	46	48	46	235	47.0
Year 3 <u>1981**</u>	<u>.56**</u>	<u>.50*</u>	<u>.53*</u>	<u>.53*</u>	<u>.52*</u>	<u>264</u>	52.8
Totals	148(3)	141	142	147	140	718(15)	

* Data used in exhibit 1, section 4.63r, are hypothetical.

** Data are from exhibit 1, section 4.63c; all other figures for this year are hypothetical. Note sample size (n) in parenthesis.

- a. Calculate the sum of squares (SS) for the following:

- 1 Total
- 2 Years (y)
- 3 Belts (B)
- 4 Error

Begin by calculating the correction term (CT).

$$CT = \frac{(\sum x)^2}{N} = \frac{718^2}{15} = 34368.26$$

$$SS = \frac{\sum x^2}{N} - CT$$

$$\begin{aligned} \text{Total SS} &= 44^2 + 44^2 + 43^2 + 46^2 + 42^2 + 48^2 + 47^2 + 46^2 + 46^2 + 48^2 + 46^2 + 46^2 + 46^2 + 46^2 + 46^2 - CT \\ &= 34608 - 34368.26 \\ &= 239.74 \end{aligned}$$

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RANGE ANALYSIS HANDBOOK

*- Year SS = $\frac{219^2 + 235^2 + 264^2}{5 \text{ (No. of belts)}} - CT$

$$= 34576.4 - 34368.26$$

$$= 208.14$$

Belt SS = $\frac{148^2 + 141^2 + 142^2 + 147^2 + 140^2}{3 \text{ (No. of years)}} - CT$

$$= 34386 - 34368.26$$

$$= 17.74$$

Error SS = Total SS - Year SS - Belts

$$= 239.74 - 208.14 - 17.74$$

$$= 13.86$$

b. Calculate the mean square (MS) for the years belts and error.

$$MS = \frac{SS}{df}$$

The degrees of freedom "df" associated with the number of years can be obtained from the following table, where 5 belts were measured during each reading:

Number of Readings	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>
Years df	1	2	3	4	5	6	7
Belts df	4	4	4	4	4	4	4
Error df	4	8	12	16	20	24	28
Total df	9	14	19	24	29	34	39

The "df" is always one less than the number of observations involved in each total. The error "df" is obtained by subtracting the year and belt "df" from the total.

$$\text{Years MS} = \frac{\text{Year SS}}{\text{Year df}} = \frac{208.14}{2} = 104.07$$

$$\text{Belt MS} = \frac{\text{Belt SS}}{\text{Belt df}} = \frac{17.74}{4} = 4.35$$

$$\text{Error MS} = \frac{\text{Error SS}}{\text{Error df}} = \frac{13.86}{8} = 1.73$$

c. Calculate the f values for years and belts.

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$$*- \quad f = \frac{MS}{\text{Error MS}}$$

$$\text{Year } f = \frac{\text{Year MS}}{\text{Error MS}} = \frac{194.07}{1.93} = 60.15$$

$$\text{Belt } f = \frac{\text{Belt MS}}{\text{Error MS}} = \frac{4.35}{1.93} = 2.51$$

d. Display the data in tabular form as follows:

Source	df	SS	MS	Calculated "f"	Tabular "f"	Significance
Years	2	208.14	104.07	60.15	4.46**	Yes
Belts	4	17.74	4.35	2.51	3.84**	No
Error	8	15.46	1.73	-	-	
Total	14	*239.74				

* The individual SS must equal the total SS.

** The tabular "f" at the 95% confidence interval (see following table)

Years of Reading	Error df	Degrees of freedom (associated with years or belts)						
		1	2	3	4	5	6	7
2	4	7.71	6.94	6.95	6.39	6.26	6.16	6.09
3	8	5.32	4.46	4.07	3.84	3.69	3.58	3.50
4	12	4.75	3.88	3.49	3.26	3.11	3.00	2.92
5	16	4.49	3.63	3.24	3.01	2.85	2.74	2.66
6	20	4.35	3.49	3.10	2.87	2.71	2.60	2.52
7	24	4.26	3.40	3.01	2.78	2.62	2.51	2.43
8	28	4.20	3.34	2.95	2.71	2.56	2.44	2.36

In the previous example, the calculated "f" (2.51) for the belts does not exceed the tabular "f" (3.84); therefore, there is no significant difference between belts. From this, it is concluded the site was properly selected and the study was installed and remeasured correctly. The calculated "f" (60.15) for years exceeds the tabular "f" (4.46); this clearly indicates there is a significant difference between years. However, since there are three (3) years of readings, the LSD test must be performed to determine which of the years are different.

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- *- e. Compute the Least Significant Difference (LSD) to determine the amount of change needed between yearly means ($\bar{x}$) for a change to be considered significant.

$$LSD = t_{df} = \sqrt{ms(\text{error}) \frac{1}{n_i} + \frac{1}{n_j}}$$

The "t" value at 95% confidence limit with 8 degrees of freedom for the error is obtained from the "t" table contained in exhibit 8, table 2, section 2.4ld.

$$LSD = t_{.95} = \sqrt{1.73 \frac{1}{5} + \frac{1}{5}}$$

$$= 2.131 \sqrt{.692}$$

$$= 1.91$$

In the event data from one or two of the belts were not evaluated because of significant difference between beltlines, the number of observations (n) in this calculation (i.e., 5) would change according (i.e., 3 or 4) to the number of beltlines used to make the yearly comparisons.

Where only two years of data are available, there is no need to perform the LSD test as described. However, in order to determine the amount of change in yearly means, which is needed for a significant change, the following formula can be used:

$$D = t_{4d} S_{\bar{x}} \sqrt{2}$$

where D = the difference in yearly means needed for a significant change.

$$S_{\bar{x}} = \sqrt{\frac{\text{Error MS}}{5}}$$

$$t_{4d} = 2.776 \text{ (from Section 2.4ld, Exhibit 18, Table 2)}$$

- f. Compute the differences between yearly means to determine which yearly means ($\bar{x}$) are significantly different. They can be displayed as follows and compared against the LSD.

	x	x - 42.4	Yearly $\bar{x}$ diff	Total $\bar{x}$ diff
Year 1	43.8	0	3.2	9.0
Year 2	47.0	3.2	5.8	
Year 3	52.8	9.0		

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- *- This comparison indicates the means ($\bar{x}$) between years 1 and 2 and between years 2 and 3 are significantly different since their differences exceeded 1.91. In this example, the number of occurrences of desirables increased and an upward trend is indicated for years 2 and 3.

The evaluation is accomplished in the same manner for all other attributes regardless of the number of years. The associated degrees of freedom (df) would change with the number of times a particular study was remeasured.

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RANGE ANALYSIS HANDBOOK

Exhibit 1

NESTED FREQUENCY/SHRUB DENSITY Summary

 Forest Bridger - Teton District Big Piney Allotment Sherman Date 9/4/82

 Study Name/Number Horse Pasture Draw BT-25 Vegetative (Habitat) Type ARTRV / FEID

Summary by _____

DESIRABLES	Year					
	1	2	3	4	5	Total
	1964	1970	1981			
Belt 1	44	48	56			148
2	44	47	50			141
3	43	46	53			142
4	46	48	53			147
5	42	46	52			140
Total	219	235	264			718
Mean $\bar{x}$	43.8	47.0	52.8			

KEY SPECIES	Year					
	1	2	3	4	5	Total
	1964	1970	1981			
Belt 1	6	14	16			36
2	5	12	14			31
3	8	15	19			42
4	7	13	15			35
5	8	13	15			36
Total	34	67	79			180
Mean $\bar{x}$	6.8	13.4	15.8			

INTERMEDIATES	Year					
	1	2	3	4	5	Total
	1964	1970	1981			
Belt 1	60	56	45			161
2	59	57	43			159
3	63	60	52			175
4	64	58	51			173
5	65	60	49			174
Total	311	291	240			842
Mean $\bar{x}$	62.2	58.2	48.0			

BARE SOIL	Year					
	1	2	3	4	5	Total
	1964	1970	1981			
Belt 1	22	21	8			51
2	23	19	12			54
3	24	22	10			56
4	22	18	11			51
5	21	19	12			52
Total	112	99	53			264
Mean $\bar{x}$	22.4	19.8	10.6			

LEAST DESIRABLES	Year					
	1	2	3	4	5	Total
	1964	1970	1981			
Belt 1	8	6	2			16
2	9	5	4			18
3	8	4	5			17
4	5	3	2			10
5	7	4	3			14
Total	37	22	16			75
Mean $\bar{x}$	7.4	4.4	3.2			

SHRUB DENSITY and/or COVER (ARTRV)	Year					
	1	2	3	4	5	Total
	1964	1970	1981			
Belt 1	210	41	64			315
2	180	43	58			281
3	208	36	68			312
4	135	33	60			228
5	146	31	55			232
Total	879	184	305			1368
Mean $\bar{x}$	175.8	36.8	61.0			

R4-2700-23/82

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*- 4.63s - Assessment of Trend.

Each parameter or set of parameters which were summarized on R4-2200-23 should be carefully evaluated and a trend rating assigned (up, down, or static) based on the significance of the change and the direction of that change. Form R4-2200-26 (7/82), Nested Frequency/Shrub Density Evaluation Record shown in exhibit 1 is used to document these changes and the basis for the final assessment of trend.

The following guidelines can be used as an aid in defining the direction of change for the variable monitored.

1. A static trend would be assigned to changes which are not significant, i.e., calculated values which are less than the LSD value.
2. The individual component, i.e., D, I, or L which shows the most change will often dictate the direction of the overall change.
3. A shift to a lower desirability, i.e., the loss of desirables with an increase of intermediates and/or least desirables, would indicate a downward ecological trend.
4. Significant increase in ground cover would indicate an upward soil trend.
5. An increase in the number of shrubs could indicate either a downward or an upward trend. This would depend on the site potential and the shrub species involved. On a grassland site, an increase in woody vegetation could imply a downward ecological trend.
6. A shift in the age class of a particular shrub may also indicate the direction of change. An increase in the older age categories of a sagebrush stand may denote an upward ecological trend.
7. Reduced quantities or loss of species normally found in the habitat type would indicate a downward ecological trend; i.e., Idaho fescue within a sagebrush stand lost due to heavy grazing or fire.

Although the trend rating assigned to each parameter may not always agree with each other; an overall rating for the vegetation and soil should be assigned. Assigning a trend rating to the soil normally does not present any problems; however, rating the overall vegetative trend can be difficult particularly where conflicting trends are indicated by the various parameters. Generally speaking, the overall trend will normally be that which occurs more often when all parameters are considered. The investigator must exercise professional judgment in deciding on the overall vegetative trend. This decision should be based on the significance and direction of change.

The following example serves to illustrate an assessment employing the analysis of variance technique described.

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*- Belt	Desirables				Intermediates				Least Desirables			
	(1)	(2)	(3)	Total	(1)	(2)	(3)	Total	(1)	(2)	(3)	Total
	1964	1970	1981		1964	1970	1981		1964	1970	1981	
1	44	48	56*	148	60	56	45*	161	8	6	2*	16
2	44	47	50	141	59	57	43	159	9	5	4	18
3	43	46	53	142	63	60	52	175	8	4	5	17
4	46	48	53	147	64	58	51	173	5	3	2	10
5	42	46	52	140	65	60	49	174	7	4	3	14
Total	219	235	262	718	311	291	240	842	37	22	16	75

x	43.8	47.0	52.8	62.2	58.2	48.0	7.4	4.4	3.2
Difference	3.2 5.8 9.0			4.0 10.2 14.2			3.0 1.2 4.2		

LSD =	1.91	2.29	1.44
Years Different	1,2,& 3	1 and 3, 2 and 3	1 and 2, 1 and 3
Years Not Different			2 and 3
Short-Term			
Change	Gain	Loss	None
Long-Term			
Change	Gain	Loss	Loss

* Data taken from exhibit 1, section 4.63c.

Based on comparisons of the LSD values against the differences in years, several changes are noted to be significant on both short- and long-term trends.

The assessment of short-term trend (year 2 versus year 3) would be as follows:

The significant gain in desirables and loss of intermediates would signify an upward trend due to a shift toward a higher desirability. However, an overall downward trend is indicated since the magnitude in loss of intermediates is not outweighed by the gain in desirables while least desirables exhibit no change.

The assessment of long-term trend (year 1 versus year 3) would be as follows:

A significant change is noted on all three parameters. Upward vegetative trends are indicated by the gain in desirables and a loss in least desirables. The loss of both intermediates and least desirables coupled with a gain in desirables indicates a shift towards a higher desirability class; therefore, an upward trend is substantiated.

—*

RANGE ANALYSIS HANDBOOK

Exhibit 1

NESTED FREQUENCY/SHRUB DENSITY Evaluation Record

 Forest Bridger-Teton District Big Piney Allotment Sherman Date 8/10/82

 Study Name/Number Horse Pasture Draw BT-25 Vegetation (Habitat) Type ARTRV / FEID

Evaluation by _____

DESIRABLES	Year				
	1	2	3	4	5
	1964	1970	1981		
Mean $\bar{x}$	43.8	47.0	52.8		
$\bar{x}$ Difference:					
Short Term	Yr 1-2 3.2	Yr 2-3 5.8	Yr 3-4	Yr 4-5	
Long Term	Yr 1-2 3.2	Yr 1-3 9.0	Yr 1-4	Yr 1-5	
LSD	1.03	1.91			
Change: Short Term	Gain	Gain			
Long Term		Gain			

KEY SPECIES	Year				
	1	2	3	4	5
FEID	1964	1970	1981		
Mean $\bar{x}$	6.8	13.4	15.8		
$\bar{x}$ Difference:					
Short Term	Yr 1-2 6.6	Yr 2-3 2.9	Yr 3-4	Yr 4-5	
Long Term	Yr 1-2 6.6	Yr 1-3 9.0	Yr 1-4	Yr 1-5	
LSD	1.41	1.27			
Change: Short Term	Gain	Gain			
Long Term		Gain			

INTERMEDIATES	Year				
	1	2	3	4	5
	1964	1970	1981		
Mean $\bar{x}$	62.2	58.2	48.0		
$\bar{x}$ Difference:					
Short Term	Yr 1-2 4.0	Yr 2-3 10.2	Yr 3-4	Yr 4-5	
Long Term	Yr 1-2 4.0	Yr 1-3 14.2	Yr 1-4	Yr 1-5	
LSD	1.95	2.29			
Change: Short Term	Loss	Loss			
Long Term		Loss			

BARE SOIL	Year				
	1	2	3	4	5
	1964	1970	1981		
Mean $\bar{x}$	22.4	19.8	10.6		
$\bar{x}$ Difference:					
Short Term	Yr 1-2 2.6	Yr 2-3 9.2	Yr 3-4	Yr 4-5	
Long Term	Yr 1-2 2.6	Yr 1-3 11.8	Yr 1-4	Yr 1-5	
LSD	1.66	2.35			
Change: Short Term	Loss	Loss			
Long Term		Loss			

LEAST DESIRABLES	Year				
	1	2	3	4	5
	1964	1970	1981		
Mean $\bar{x}$	7.4	4.4	3.2		
$\bar{x}$ Difference:					
Short Term	Yr 1-2 3.0	Yr 2-3 1.2	Yr 3-4	Yr 4-5	
Long Term	Yr 1-2 3.0	Yr 1-3 4.2	Yr 1-4	Yr 1-5	
LSD	1.20	1.44			
Change: Short Term	Loss	None			
Long Term		Loss			

SHRUB DENSITY and/or COVER	Year				
	1	2	3	4	5
ARTRV	1964	1970	1981		
Mean $\bar{x}$	175.8	36.8	61.0		
$\bar{x}$ Difference:					
Short Term	Yr 1-2 139	Yr 2-3 24.2	Yr 3-4	Yr 4-5	
Long Term	Yr 1-2 139	Yr 1-3 114.8	Yr 1-4	Yr 1-5	
LSD	38.8	26.4			
Change: Short Term	Loss	None			
Long Term		Loss			

RA-2200-26 7/82

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Exhibit 1 (Continued)

TREND ASSESSMENT

Short Term Trend:
Basis for assessment:

Vegetation: Static (→) Soil: up (↑)

Vegetation: short term trend in vegetation is considered static due to the Gain in Desirables and FEID coupled with the loss in Intermediates while Least Desirables and ARTRV did not change; it would appear that any previous improvement has slowed down.

Soil: short term trend in soil is considered up (↑) due to the significant loss (decrease) in the amount of bare soil.

Long Term Trend:
Basis for assessment:

Vegetation: up ↑ Soil: up ↑

Vegetation: Long term trend in vegetation is considered up due to the shift towards a higher desirability as is indicated by the Gain in Desirables coupled with the loss of Intermediates and Least Desirables. It is further substantiated by the gain in FEID and loss of ARTRV.

Soil: Long term trend in soil is up due to the significant loss in the amount of bare soil.

Assessment of SHRUB DENSITY and/or COVER ARTRV

Short Term Trend

Basis for assessment:

cover measurements taken with Line Intercept indicate no change in the cover of ARTRV occurred between years 2 and 3. Therefore trend is considered to be STATIC (→).

Long Term Trend

Basis for assessment:

cover measurements between years 1 and 3 verify a significant loss in the amount of ARTRV therefore an upward (↑) trend is indicated.

BUREAU OF LAND MANAGEMENT
NESTED DENSITY-CHARACTERIZATION PROCEDURE

The nested density-characterization procedure is the method currently being utilized by the Bureau of Land Management in Utah. The following guidelines are taken directly from the Bureau's instructions to their field personnel.



United States Department of the Interior

BUREAU OF LAND MANAGEMENT
UTAH STATE OFFICE
136 E. SOUTH TEMPLE
SALT LAKE CITY, UTAH 84111

IN REPLY REFER TO

4412.2
(U-932)

Instruction Memorandum No. UT 81-267
Expires 9/30/82

To: AFOs

From: State Director, Utah

Subject: Rangeland Monitoring Procedures

The attached Utah Guidance for Range Studies provides the primary procedures to be used in establishing new rangeland monitoring studies in Utah. This guidance is consistent with procedures outlined in the Draft Manual Section 4430 (IM No. DSC-81-109) and will be updated into a manual supplement when the Manual is released.

Established trend studies should be retained or at least re-photographed periodically. They may also be expanded using the attached methodology if necessary.

The procedures should work well for most vegetation types in Utah, but we realized there will be situations where alternative study methods will be preferable. If you plan to use another method, submit the proposed method and reasons to UT-930 for approval.

Earlier in May, the trend method was field tested in several vegetation types. Some of our findings were:

1. The square nested plot (3 x 3' or 5 x 5') was preferred over the 9.6 ft.2 circle.
2. Seedlings and annuals should be listed if they occur, but do not need to be counted since yearly climate fluctuations account for most of the variability in these.
3. The distance between plots does not have to be precisely 100', but can be somewhat less in order to locate plots so they contain some of the key species for the area. The exact distance should be measured and recorded on the location map.

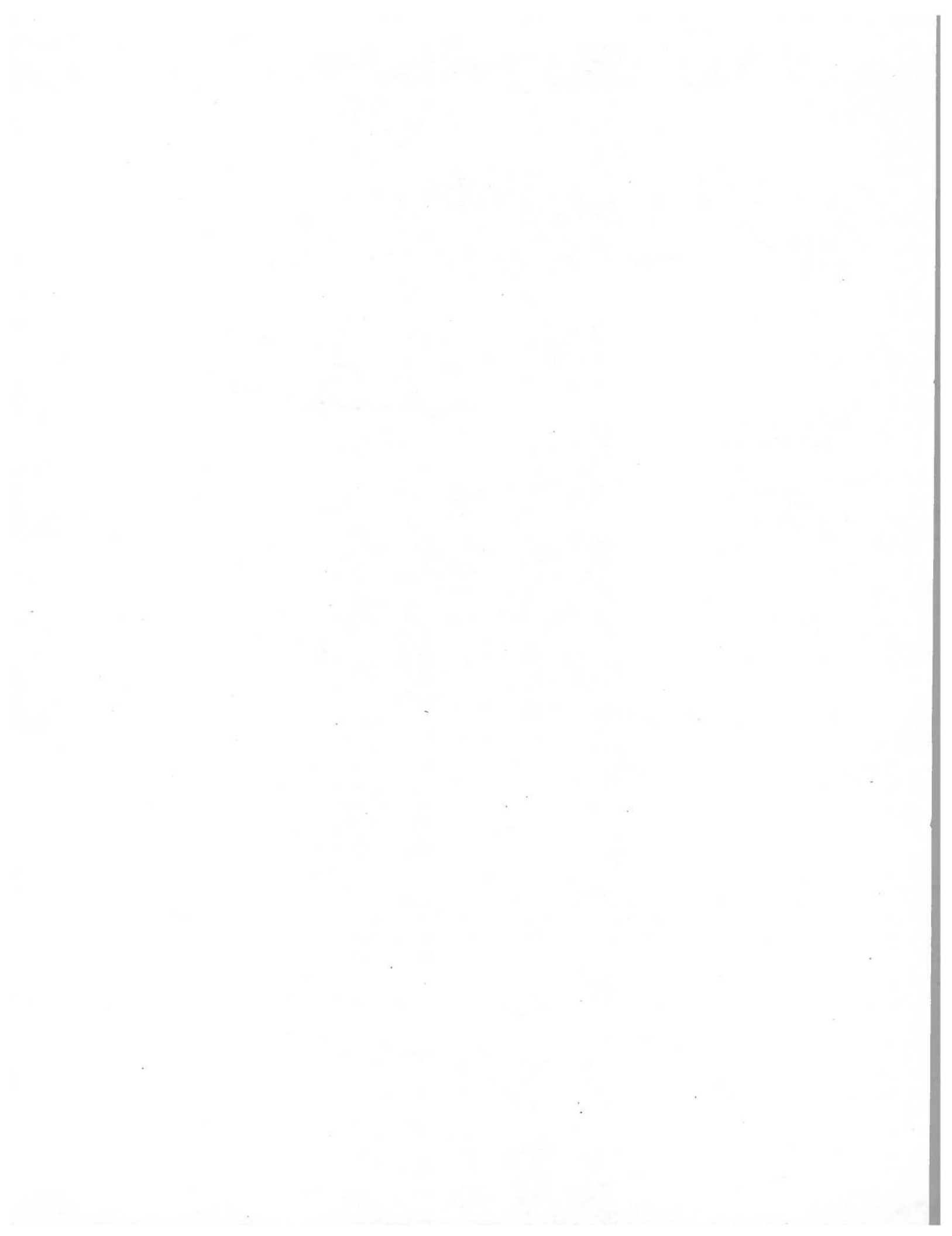
We will conduct a training session at the Cedar City District Office on June 10, 1981, at 8:00 a.m. through the morning of June 12, 1981. Each District should try to send their District Range Conservationist and the Area's Supervisory Range Conservationist, if possible, on this short notice. Weather permitting, one day will be in the field.

Enclosure
Utah Guidance for
Range Studies



ACTING

Distribution
SCD, D-245 (2)
Director, W-221



Utah Guidance for Range Studies

4412.2 Rangeland Monitoring Studies are the Bureau's tools used to measure and interpret soil and vegetative changes brought about by management action and/or natural events such as climate. The purpose of this supplement is to provide additional guidance for conducting Utah Rangeland Monitoring Studies, on an interim basis, until BLM Manual 4412.2 is rewritten and implemented. Study examiners should be familiar with basic considerations and procedures set out in the existing Manual 4412.2 as well as this supplement.

.21 Basic Considerations

A. Objectives of the studies should:

1. Provide Procedures for gathering sufficient field data to:
 - a. Serve as a base for interpreting and evaluating management plans or strategies; including verify or adjust livestock and/or wild ungulate populations after initial stocking rates are set,
 - b. offer comparison between present management strategies and site potential,
 - c. support other production-oriented studies.
2. Involve a multidiscipline approach to avoid duplication of effort and allow maximum efficiency.

B. Priorities

1. Allotments will receive studies in the following priority:
 - a. Problem or highly important allotments,
 - b. Allotments under AMP's or grazing systems,
 - c. Allotments where management is planned,

d. All remaining allotments.

2. Conducting studies will be as follows:

a. Establish complete set of studies (excluding climate) on allotments according to criteria set out in 4412.21B1 above.

b. Establish climate studies representative areas or areas where there are data voids to supplement existing weather station data.

c. Conduct studies to provide data necessary to verify or adjust stocking rates for livestock and/or wild ungulate populations, adjust seasons of use for livestock, and evaluate progress in achieving management objectives for vegetation resources.

C. Basic studies will include: actual use; utilization; trend; condition; and climate. Phenology and green weight/dry weight conversion studies such as climate/phenology correlation. These studies will be considered the standard. Additional studies (water quality; browse utilization; soil erosion; etc.) may be necessary on crucial key areas.

D. Establishing studies. They key area-key species concept will be used in all range studies.

1. Definition - A key area is a portion of a range (pasture within an allotment) which because of its location, grazing value and/or use, serves as an indicative sample of range conditions, trend or degree of use seasonally. A key area may be considered to be the "pulse" of the range (pasture within an allotment) and guides the management of the entire area of which it is a part.

2. Criteria for Establishment and Study

a. As a standard, basic studies (excluding climate) will be established on key areas in each priority allotment. A final objective is a complete set of studies (excluding climate) on each key area in each pasture of each allotment.

b. Preferably a key area should be established to represent only one vegetation-soil unit such as a site write-up area (SWA) where SVIM mapping has been completed. Where the manager feels that it is desirable to monitor more than one vegetation-soil unit on one key area, all data collected should be kept separate by site.

c. There are at least four consideration points in the planning and implementation process where key area locations should be assessed, as follows:

(1) Use MFP constraints as assessed in allotment planning and as necessary to monitor these special and critical problems. Key areas should be crucial for any or all of the following: watershed, wildlife, range.

(2) Select key areas as necessary to evaluate vegetation responses from the grazing system or use established. These key areas will normally result from fence locations and planned water development (allotment planning phase).

(3) Select key areas, as necessary, following full implementation of an AMP where actual grazing patterns are different than anticipated in the allotment planning phase.

(4) Prior to initiation of any new studies, the study site will be evaluated by the multidiscipline team. The intent should be to

establish as few studies as possible yet provide the maximum data for all disciplines. As many of these basic studies as possible should be taken in the same key or crucial key area and at the same time to minimize interpretive error and travel costs. Existing studies which provide valuable data will be retained regardless of type, but may not be read on a regular basis.

d. Key plant species (indicators of vegetation change) should be determined by a multidiscipline team. This team will be composed of range, wildlife, soils, and watershed specialists.

A key species should be abundant on a range in satisfactory condition. Grazing values may be of secondary importance. For example, watershed protection may require the selection of plants as key species that protect the watershed but are not the best forage species.

e. Comparison areas should be established for major sites to document site potential and aid in determining management objectives.

(Manual 4412.14D8)

3. Study Files will be established for each key area. A key area location sheet with diagramatic sketch (illustration 4412-1) will be prepared when studies are established. A key area number will be assigned in accordance with the well-numbering system used in Utah. (illustration 4412-2) Since there will seldom, if ever, be more than one key area in a quarter section, it should not be necessary to number beyond the quarter section code.

.22 Study Methods listed below are those recommended for Utah. Specific circumstances may warrant use of other study methods outline in Manual 4412.2

or other modified outlined in Manual 4412.2 or other modified study procedures. Alternative study procedures must be approved by the State Director prior to implementation.

A. Actual use

1. Frequency. Actual grazing use surveys (such as form 4130-5, illustration 4412-3) from operators will be taken annually at the end of the grazing season or billing year. Livestock (and wildlife) counts can be taken any time as deemed appropriate by the range manager.

2. Documentation

a. The following information will be requested from the livestock operator:

1. Allotment name - pastures grazed,
2. Livestock numbers grazed,
3. Season of use (dates).

b. Animal counts will be documented on form 4113-1 for livestock and form 6602-1 for big game.

B. Utilization

1. Frequency. Data will be collected at the end of each grazing period as soon as possible after each class of animal leaves an allotment or pasture. Where both livestock and wild ungulates use the area simultaneously, it may be necessary to compare use on adjacent non-use pastures or on differential exclosures.

2. Methodology will normally be the key forage plant method. Techniques for estimating utilization are found in Manual 4412.22B7.

a. Photographs of key species can be taken showing the

different levels of use on both grasses and shrubs to supplement transect information. Mapping should show utilization patterns according to the standard 20% class intervals. Mapping will be done in the field on topographic maps, orthophotoquads or other suitable maps or photos and kept in the allotment file. Where SVIM-type surveys have been completed, utilization patterns will normally follow SWA boundaries since present vegetation communities usually represent historic grazing patterns. Use of SWA boundaries makes it much simpler to determine acreage and areas which utilization patterns represent.

b. The following information should be shown in each map delineation: transect location; observed utilization; acreage; the location of water and other improvements.

c. Data will be recorded on form 4412-12

C. Trend data will quantify vegetation changes in terms of plant density (number of plants per unit area) by species and plant community composition by age and form class.

1. Establishing sites will use the key area concept outlined in part .21D of this supplement. Existing sites will be reviewed to insure they are well within ecological site boundaries. If a site is determined to be improperly located, the existing photo plots will be retained and a new site selected for additional studies. Further readings and calculations of trend index of existing sites will be at the discretion of the manager.

2. Frequency. Data will be collected the year prior to proposed 3 and 5 year decisions following an ES or RMP and in accordance to the frequency

key for range trend thereafter (illustration 4412-4)

3. Mapping Trend study areas will be correctly located on a topographic map or orthophotoquad and made a part of the study area's permanent file.

4. Methodology. Three permanently located plots, located 100 feet apart on line will be used (Illustration 4412-5). Under no circumstance will plants be clipped within these study plots.

a. Plot size will normally be a 9.6 square foot hoop nested within an 8.3 foot radius plot (1/200 acre).

b. Alternative size plots such as 3 x 3 or 5 x 5 foot frames or 11.7 foot radius (1/100 acre) may be considered necessary or desirable by the multidiscipline team due to exceptionally sparse or dense vegetation or the presence of existing studies utilizing a particular plot size. If a square plot is used as the nested plot, the corner marker farthest from the photo point would be used as a pivot for the 8.3 or 11.7 foot radius plot.

c. Record plant density and characterization data on form 4412-27(V-2) (illustration 4412-6).

(1) Record administrative data in items (3) thru (9).

(2) Record plot sizes in items (10) and (11).

(3) Record plot number 1 in column (13).

(4) Characterize grass and forb species in the nested plot.

(a) Record the first species to be characterized in column 14.

(b) Record average height and average crown diameter of the specie (not the individual plant) in columns (19) and (20) respectively.

(c) Record the different combinations of age and form class for that specie in columns (21) and (22). Age and form class codes are listed in form 4412-27a - instructions for record type V2.

(d) Count the number of individual plants in each age and form class combination and record on the same line in column 23.

(5) Characterize shrub and tree species in the 8.3 or 11.7 foot radius plot and record in the same manner as for grasses and forbs.

(6) Repeat (4) and (5) for plots 2 and 3.

5. For comparison purposes, the density in plants/acre can be easily calculated for each age and form class for key species and entered on a summary work sheet. The calculation would be:

Total number counted in form and age class for three plots X Constant for plot size = # plants/acre. Where: Constant for plot size = $\frac{43,560 \text{ ft.}}{3 \text{ X plot area (ft}^2\text{)}}$

Typical constants are:

$$3' \times 3' \text{ plot} = \frac{43,560}{27} = 1613.3$$

$$9.6 \text{ ft.}^2 \text{ plot} = \frac{43,560}{28.8} = 1512.5$$

$$5' \times 5' \text{ plot} = \frac{43,560}{75} = 580.8$$

6. Supplemental data may include ground cover and/or soil surface factor (SSF). The need for supplemental data will be determined by the multidisciplinary team and the manager.

a. Ground cover will be gathered utilizing a 200-point step-point transect and recorded on form 4412-26 (illustration 4412-7)

according to procedures in Manual 4412.14D2.

b. Soil Surface Factor (SSF) data will also be recorded on form 4412-26.

7. Photographs

a. A general view photograph should be taken from a camera point at the first plot toward the remaining two. A panoramic photo (three overlapping photos) may be used where necessary.

b. A close up photograph of each nested plot should be taken.

c. Identify all photos with form 4412-16 (illustration 4412-8) or with just the date and key area number (illustration 4412-9) when using that numbering system described in .21D3.

D. Phenology and Green Weight/Dry Weight Conversion studies are needed to adjust transect data and for special studies such as climate/phenology correlation.

1. Frequency. Data will be collected annually during the growing season as needed.

2. Methodology. The methodologies for these studies will be followed as set out in Instruction Memorandum Number UT-81-192 (dated March 27, 1981) regarding phenology studies and green weight/dry weight conversions.

E. Climate data is needed to make a reasonable analysis of climate influences on plant growth as related to "normal" or average years and differentiate between management-caused vegetation changes as opposed to natural occurrences.

1. Selection of sites should be based on the climatic

classification scheme used by the Soil Conservation Service (i.e., desert, semi-desert, upland, mountain, and high mountain).

2. Data needs include:

- a. Daily precipitation.
- b. Daily maximum and minimum air temperature.
- c. Daily maximum and minimum soil temperature.
- d. Additional data to improve accuracy of calculations, especially in early study phases include
 - (1) Date of last permanent snow cover.
 - (2) Soil moisture at begin growth for selected key species at representative locations then at mid and late growing season.
 - (3) Wind speed and duration.

3. Data gathering can be from a number of sources to provide adequate coverage with limited resources.

- a. Livestock operators.
- b. Remote, automatic sensing devices.
- c. Other local and federal agencies.
- d. Permanent weather stations.

.23 Evaluation of Studies' Data will be in accordance with Manual 4413.

#####

Key Area Location

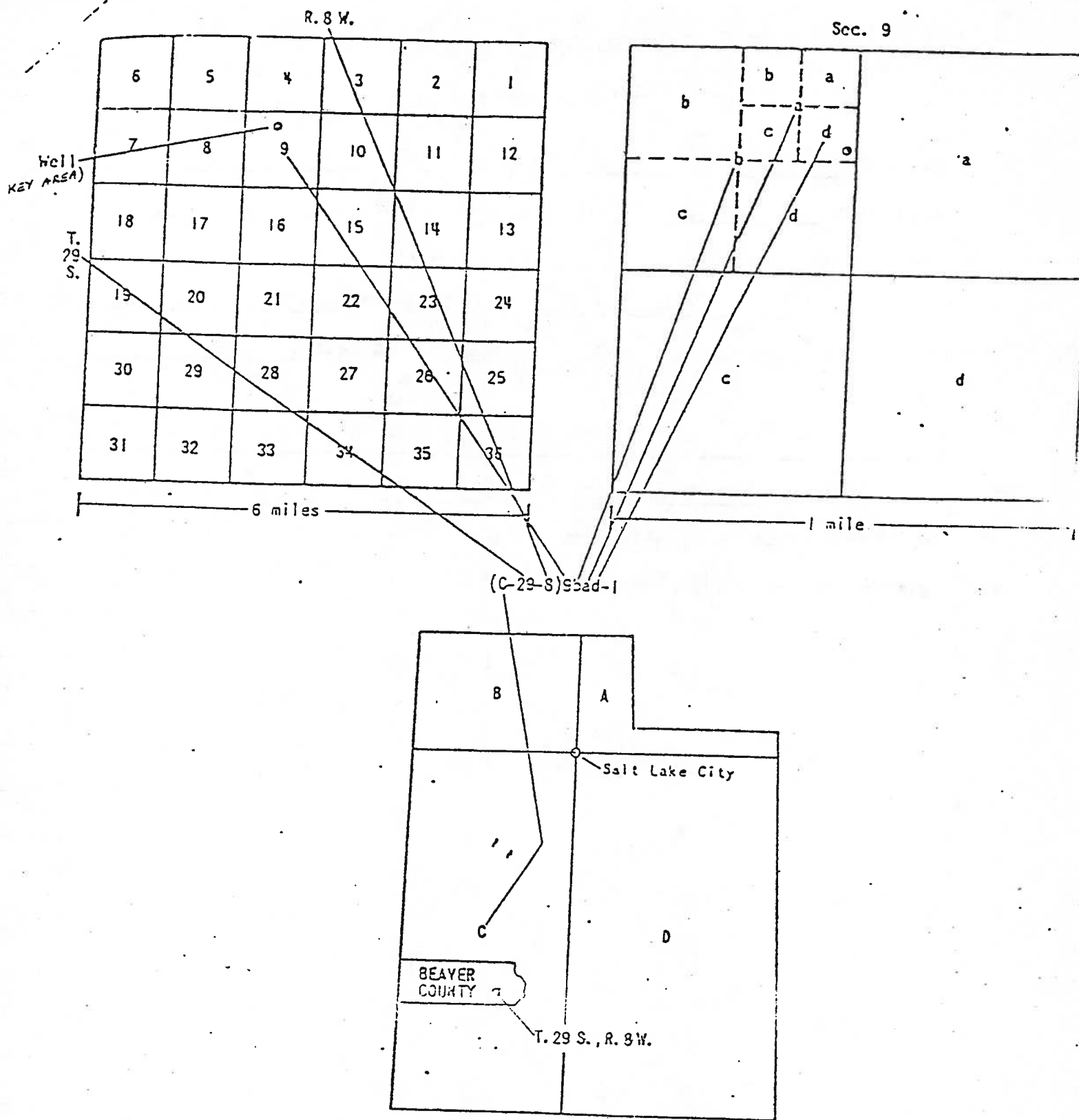
District _____ Date _____
Allotment _____ Aerial Photo # _____
Prepared by _____ or 7½' Quad _____
_____ or Orthophoto _____
Photo or Map Date _____

Location Sketch (Scale _____)

show appropriate permanent landmarks (with names and distances) in
relation to the study plot.

Sections within a township

Tracts within a section



Well-numbering system used in Utah.

* Percentage must be the same as that shown on the permit or lease.

FREQUENCY KEY FOR RANGELAND TREND-PHOTOGRAPHS

DICHOTOMOUS KEY FOR CLASSIFYING GRAZING SYSTEMS¹

	FREQUENCY CODE	FREQUENCY AND CONDITIONS FOR TREND PHOTOGRAPHS BY CODE LETTER
1. Grazing a unit ² for an entire year		
2. No rotation among pastures yearlong	- - - - A	A - Every three years at height of growth
2. One or more pastures rested yearlong		
3. Scheduled, systematic rotation . . rest-rotation	- - - - B	B - Rested pasture only - each year at height of growth
3. Flexible selection of pasture to rest.		
3. selected-rotation	- - - - B	C - Deferred Pasture each year before deferment ends
2. One or more pastures rested less than yearlong		
3. All pastures grazed once or twice per year		
4. Scheduled grazing		
5. Systematic rotation during growing season		
5. deferred-rotation	- - - - C	D - Every pasture every three years at height of growth
5. Systematic rotation during non-growing season rotational-deferment	- - - - D	
4. Flexible rotation without regard to season		
4. intermittent-rotation	- - - - C	
3. All pastures grazed 3 or more times per year		
3. short duration-rotation	- - - - A	

(65)

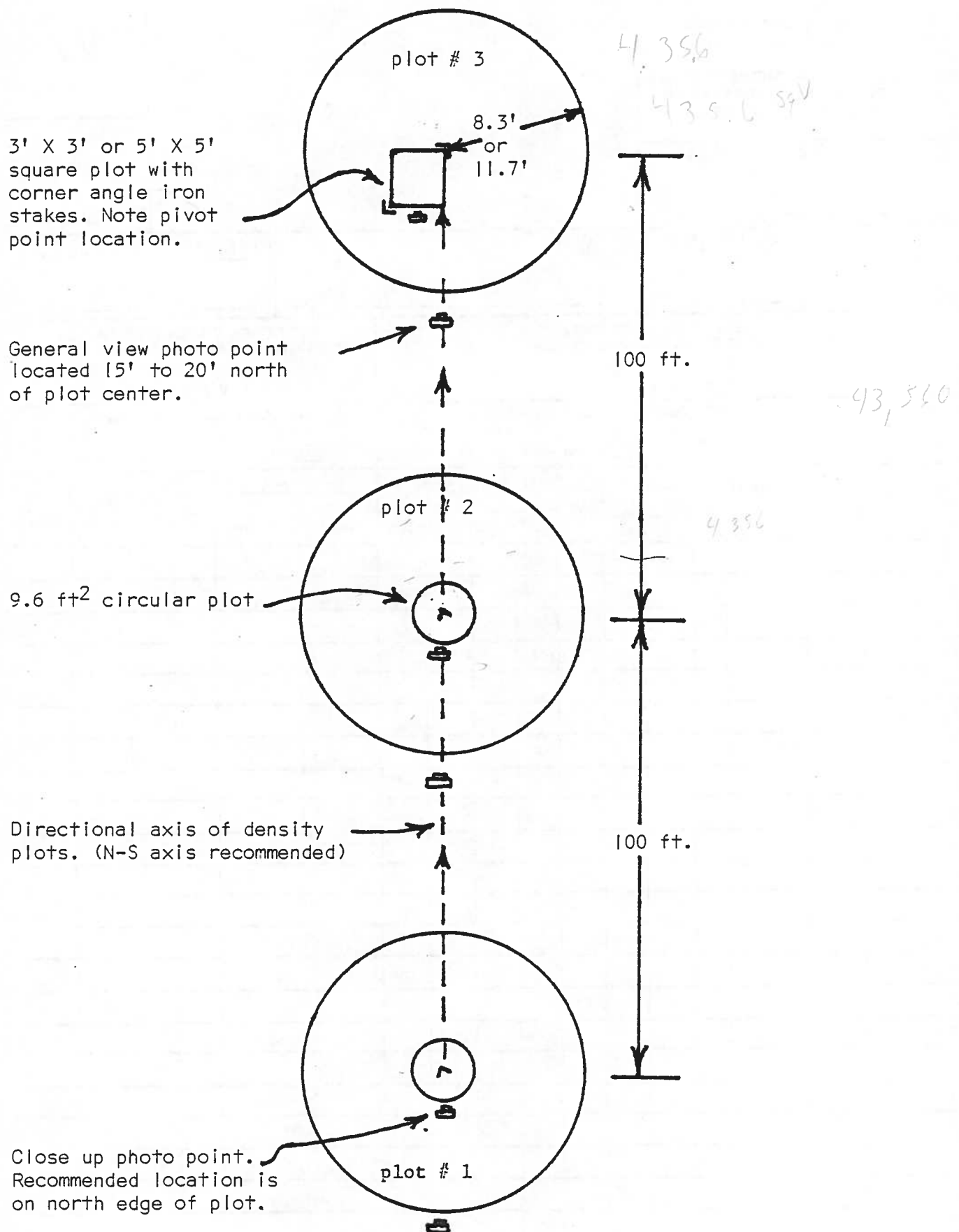
1. Grazing a unit less than a full year	
2. No rotation among pastures. . . continuous-seasonal	- - - - A
2. One or more pastures rested seasonlong	
3. Scheduled, systematic rotation. . rest-seasonal	- - - - D
3. Flexible selection on unit to rest.	
3. selected-seasonal	- - - - A
2. One or more pastures rested less than seasonlong	
3. All pastures grazed once or twice per season	
4. Scheduled grazing	
5. Systematic rotation during growing season. deferred-seasonal	- - - - C
5. Systematic rotation during nongrowing season. rotational-seasonal	- - - - D
4. Flexible rotation . . intermittent-seasonal	- - - - A
3. All pastures grazed more than twice per season	
3. short duration-seasonal	- - - - D

(1) Lacy, John R; Van Poolen, H. Walt. 1979. Grazing System Identification.
J. Range Mgt. 32(1):38-39

2/ An entire ranch or grazing allotment

FIGURE 2

DENSITY PLOT DETAIL



UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

SOIL-VEGETATION INVENTORY METHOD
WEIGHT ESTIMATE AND VEGETATION
CHARACTERIZATION DATA

Notes:

V2

(2) INV AAAX	(3) SWA ANNN	(4) TRN NN			(1) PG NNNN
---		---		---	
REC V2-1	LINE 01	(5) ACT A	(6) CA A	(7) MAP ID X(16)	(8) RECDR XXX
---		---		---	

WEIGHT ESTIMATE DATA
PLOTS TO BE CLIPPED (Circle)

VEGETATION CHARACTERIZATION
PLOTS TO BE CHARACTERIZED (Circle)

1 2 3 4 5 6 7 8 9 10										1 2 3 4 5 6 7 8 9 10									
(10) PLOT SIZE (Check One)										(11) PLOT SIZE (Check One)									
☐ .96 ☐ 9.60 ☐ Other -----										☐ 100th ☐ 200th									
LINE NN	(12) ACT A	(13) PLT NUM NN	(14) PLNT X(5) NN	AVERAGE			(18) GREEN WEIGHT IN GRAMS NNNN				AVERAGE		(21) AGE CL A	(22) FORM CL N	(23) NUM CHARZ NNN	(24) NOT CHARZ NNN			
				(15) AVAIL A	(16) PHNO N	(17) UTIL N	HGT 1		HGT 2		(19) HGT NN.NN	(20) DIA NN.NN							
				EST	CLIP	EST	EST												
02																			
03																			
04																			
05																			
06																			
07																			
08																			
09																			
10																			
11																			
12																			
13																			
14																			
15																			
16																			
17																			
18																			
19																			
20																			
21																			
22																			
23																			
24																			

(Instructions on reverse)

ABCDEF GHIJ KLMNO PQRSTU VWXYZ 1 2 3 4 5 6 7 8 9 0

Form 4412-27 (April 1982)

GENERAL INSTRUCTIONS

Beneath each field heading are Alpha, Numeric, or Alphanumeric Codes, indicating the size of the field.

A - ALPHA CODE: A-Z
N - NUMERIC CODE: 0-9
X - ALPHANUMERIC CODE: Any combination of Alpha and Numeric or special (e.g., ., -) characters. For any A, N, or X Code followed by a number in parenthesis, the number indicates field size.

For Alpha and Numeric Codes, see bottom front of form.

SPECIFIC INSTRUCTIONS

Item	Data Element	
1	3518	PAGE NUMBER - Enter consecutive page numbers for all Transects (V1, V2) for entire inventory area (See instruction from V1 form).
2	3940	INVENTORY CODE - Enter Inventory Code, e.g., Worland Dist. Inventory = 1, WOR1.
3	3507	SITE WRITEUP AREA - Enter code as assigned by the field office. Code must be unique and in consecutive order within an inventory area, e.g., A001.
4	3508	TRANSECT NUMBER - Enter number (01 thru 99). If more than one transect per SWA, numbers must be consecutive and unique.
5	7350	ACTION CODE - Applies to V2-1 record. Enter "A" to add record, "C" to change existing data, or "D" to delete existing record.
6	3572	COMPARISON AREA - Enter "C" if data is from Comparison Area, otherwise, leave blank.
7	3582	MAP IDENTIFIER - Enter Aerial Photo Number, Topographic Map Name, Quad Name, etc.
8	6525	RECORDER - Enter Recorder's initials.
9	6618	DATE - Enter Date of Recordation (YR, MO, Day). NOTE: If items 5 thru 9 above have been recorded on the V1 form (Step-point Transect Data) they need not be filled out on this form.
10	3510	PLOT SIZE - Check the box for plot size used in the weight estimate of grasses, forbs, shrubs, and trees. If "other" box is checked, enter specific plot size. NOTE: That all grasses and forbs are characterized within the weight est. plot.
11	3514	PLOT SIZE - Check the box for plot size used for shrub and tree characterization.
12	7350	ACTION CODE - Applies to V2-2 record. Enter "A" to add record, "C" to change existing data, or "D" to delete existing record.
13	3512	PLOT NUMBER - Enter plot number from which weight estimate and/or characterization data is being collected.
14	2646	PLANT CODE - Enter alpha or alpha and special character(s) part of the plant code in first column and numeric part in second column for plants within plot. If plot has no vegetation, enter the word BARE in first column.
15	3830	AVAILABILITY - Enter average availability by plant species occurring in the plot. Code as follows: A - Available 100% P - Partially Available 75% H - Half Available 50% L - Limited Availability 25% U - Unavailable 0%

Item	Data Element	
16	3712	PHENOLOGY - Enter average phenology by plant species occurring in the plot. Code as follows: 1 - Begin Growth 2 - Vegetative Stage 3 - Boot Stage 4 - Peak Flowering 5 - Seed Ripe 6 - Mature 7 - Dormant 8 - Regrowth
17	3832	UTILIZATION - Enter average utilization by plant species occurring in the plot. Code as follows: 0 - 0% 1 - 01 to 20% 2 - 21 to 40% 3 - 41 to 60% 4 - 61 to 80% 5 - 81 to 100%
18	3941	GREEN WEIGHT IN GRAMS - Enter weight (EST CLIPPED) to the nearest gram by plant species (NO TRACES), for each height category (D.E. 3523) as follows: Ht 1 = 0 - 1 1/2' Ht 2 = > 4 1/2' - 7' Ht 3 = > 7' (Enter the clipped weights for height 1 in column provided.)
19	3504	HEIGHT - Enter the plot average height in feet and hundredths of feet for the plant species characterized.
20	3522	DIAMETER - Enter the plot average basal diameter for grasses or crown diameter for forbs, shrubs, and trees.
21	3502	AGE CLASS - Enter age class for each plant species characterized, use separate lines for each age class. Code as follows: S - Seeding Y - Young M - Mature D - Decadent O - Old (Trees Only) P - Pole Sapling (Trees Only) R - Resprout (Shrubs Only)
22	3503	FORM CLASS - Enter form class for each plant species characterized. Use separate lines for each form class. Code as follows: 1 - Normal and Vigorous 2 - Dying Center (Grasses Only) 3 - Hollow Center (Grasses) - Portion Dead or Dying (Forms, Shrubs, Trees) 4 - Clump Edge (Grasses Only) 5 - Dead (If form class 3, do not record average height, diameter, or age class.)
23	3918	NUMBER CHARACTERIZED - Enter number of all grass and forb plants encountered within the weight estimate plot. For shrub and tree species encountered characterize a minimum of five (5) plants each.
24	3531	NUMBER NOT CHARACTERIZED - Enter the number of shrubs and trees in excess of the number characterized.

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
SOIL-VEGETATION INVENTORY METHOD
STEP-POINT TRANSECT DATA

Notes:

VI

(2) INV AAAX	(3) SWA ANNN	(4) TRN NN			(1) PG NNNN
REC V1-1	LINE 01	(5) ACT A	(6) CA A	(7) MAP ID X(16)	(8) RECDR XXX
					(9) DT (YYMMDD)

(10) SOIL SURFACE FACTOR RATING

RTG NN	SOIL MOVEMENT	SURFACE LITTER	SURFACE ROCK	PEDESTALLING	FLOW PATTERNS	RILLS	GULLIES
REC V1-2							

(11) OBSERVED PLNT LIST

LINE	(5) ACT	PLNT X(5)	NN	PLNT X(5)	NN	PLNT X(5)	NN	PLNT X(5)	NN	PLNT X(5)	NN	PLNT X(5)	NN
02													
03													
04													

(12) GROUND COVER DATA

BASAL	B BARE GROUND	P PERSIST LITTER	N NON- PERSIST LITTER	G GRAVEL (2MM-3")	C COBBLE (3"-10")	S STONE (10"-)	R BEDROCK
DOT COUNT							
HITS NNN							

(13) BASAL AND CANOPY GROUND COVER

LINE	(5) ACT	BASAL X(5)	NN	CANOPY 1 X(6)	NN	CANOPY 2 X(6)	NN	CANOPY 3 X(6)	NN	(14) HITS NNN
06										
07										
08										
09										
10										
11										
12										
13										
14										
15										
16										

(Instructions on reverse)

ABCDEF GHIJ KLMNOP QRSTUV WXYZ 1 2 3 4 5 6 7 8 9 0

Form 4412-26 (April 1982)

GENERAL INSTRUCTIONS

Comments:

Beneath each field heading are Alpha, Numeric, or Alphanumeric Codes, indicating the size of the field.

A - ALPHA CODE: A-Z

N - NUMERIC CODE: 0-9

X - ALPHANUMERIC CODE: Any combination of Alpha and Numeric or special (e.g., +) characters. For any A, N, or X code followed by a number in parenthesis, the number indicates field size.

For Alpha and Numeric Codes, see bottom front of form.

SPECIFIC INSTRUCTIONS

Item Data Element

- 1 3518: PAGE NUMBER - Enter consecutive page numbers for all Transects (V1, V2) for entire inventory area. All SWA and Transect numbers should also be in consecutive order to simplify checking and correcting your data. E.g.,

FORM	PAGE NUMBER	SWA	TRANSECT
V1	1	A001	01
V2	2	A001	01
V1	4	A002	01
V2	5	A002	01
- 2 3940 INVENTORY CODE - Enter Inventory Code, e.g., Worland Dist. Inventory # 1, WOR1.
- 3 3507 SITE WRITEUP AREA - Enter code as assigned by the field office. Code must be unique and in consecutive order within an inventory area, e.g., A001.
- 4 3508 TRANSECT NUMBER - Enter number (01 thru 99). If more than one transect per SWA, numbers must be consecutive and unique.
- 5 7350 ACTION CODE - Enter "A" to add record, "C" to change existing data, or "D" to delete existing record.
- 6 3572 COMPARISON AREA - Enter "C" if data is from Comparison Area, otherwise leave blank.
- 7 3582 MAP IDENTIFIER - Enter Aerial Photo Number, Topographic Map Name, Quad Name, etc.
- 8 6525 RECORDER - Enter Recorder's initials.
- 9 6618 DATE - Enter Date of Recordation (YR, MO, Day).
- 10 4817 SOIL SURFACE FACTOR RATING - Enter a value for each item as determined for entire transect. Items that do not apply enter zero or leave blank.
- 11 2646 OBSERVED PLANT LIST - Record other plants observed but not encountered on step-point transect. See item 13 below for plant coding instructions.
- 12 3527 GROUND COVER DATA - Enter dot count for each type of ground cover and total the hits by category.
- 13 2646 or 3526 BASAL AND CANOPY GROUND COVER - Enter appropriate ground cover and/or plant codes encountered at each level. For plant coding enter the alpha or alpha and special character(s) part of the plant code in first column and numeric part in second column. If canopy exceeds 20' precede plant code by asterisk. E.g., *POTR.
- 14 3527 BASAL AND CANOPY HITS - Enter total hits for each basal and/or canopy combination (record dot count on margin).

DATE

DIST

ALLOT

PASTURE

PLOT NO.

STUDY _____ DENSITY/AGE-FORM CLASS SUMMARY

KEY SPP

YR. _____

SPP

#/AGE-FORM CLASS TOTAL

#/AGE-FORM CLASS TOTAL

#/AGE-FORM CLASS TOTAL

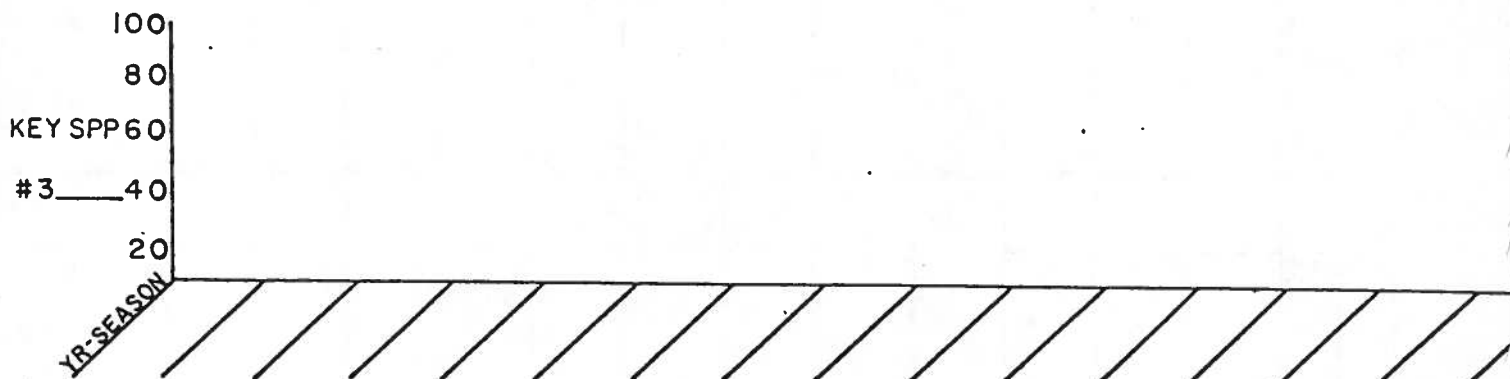
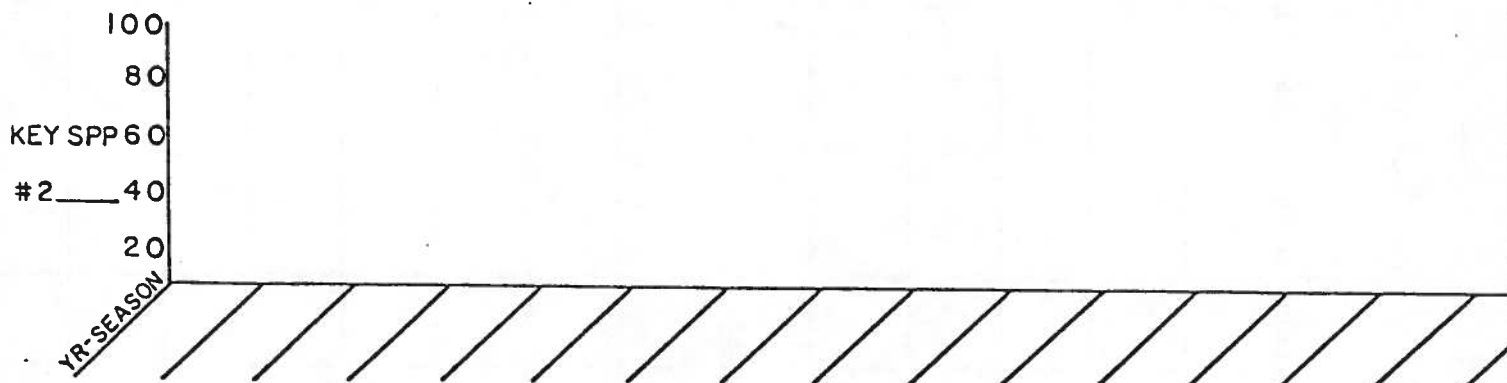
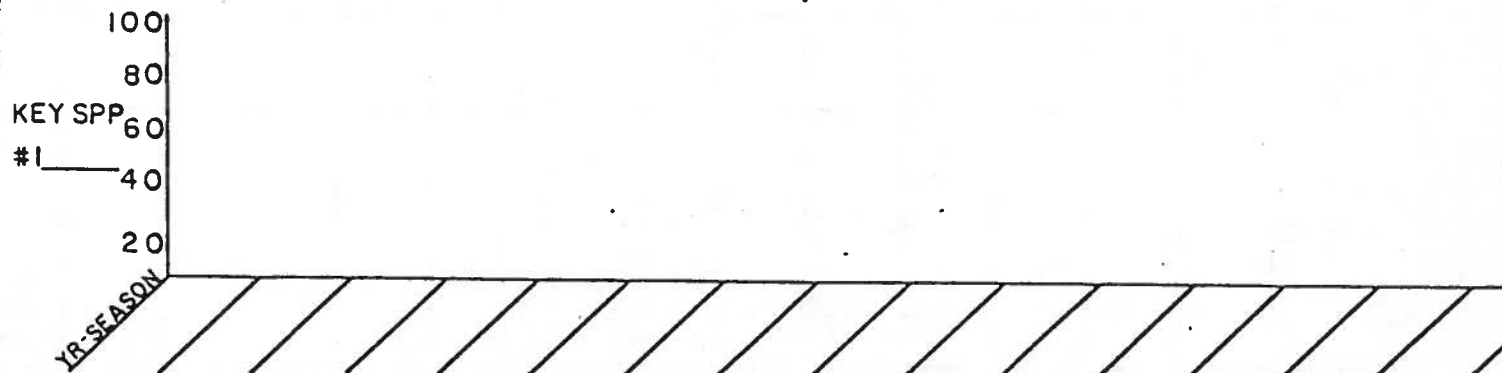
#/AGE-FORM CLASS TOTAL

#/AGE-FORM CLASS TOTAL

KEY SPECIE UTILIZATION SUMMARY

OBSERVED UTILIZATION — — — —

ADJUSTED UTILIZATION —————



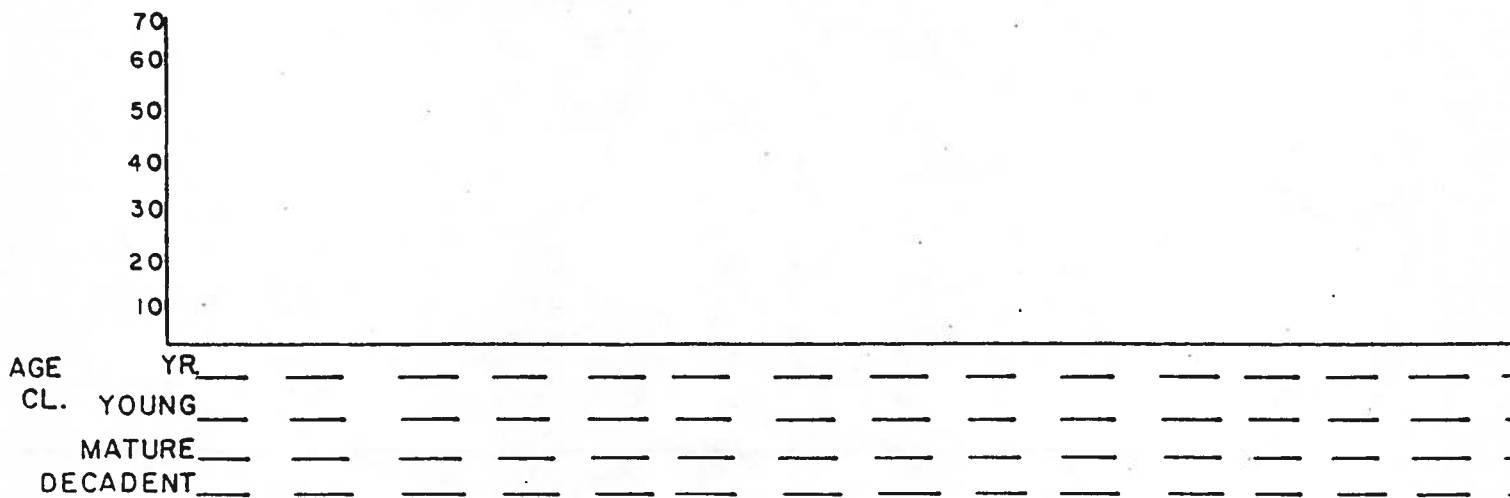
CLIMATE ADJUSTMENT USED

YR. _____
ADJ. _____

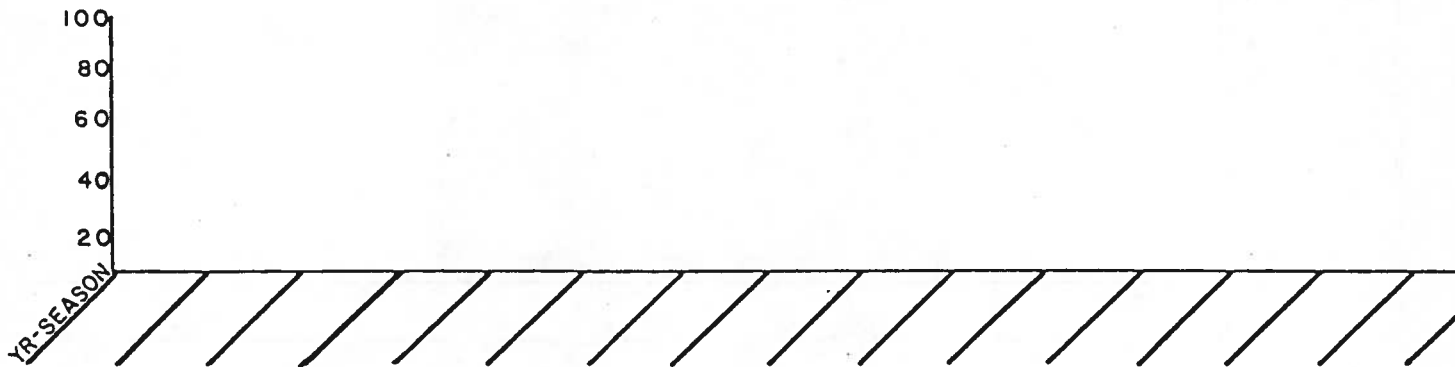
STUDY _____

KEY SPECIE DENSITY/UTILIZATION SUMMARY

TOTAL# PLANTS (3 PLOTS)- KEY SPP _____



UTILIZATION



OBSERVED UTILIZATION _____

ADJUSTED UTILIZATION _____

CLIMATE ADJUSTMENT USED

YR. _____
ADJ. _____

KEY SPECIE DENSITY SUMMARY

TOTAL # PLANTS (3 PLOTS)

YOUNG -----
MATURE
DECADENT -----

70
60
50
40
30
20
10
KEY SPP
#1

YR. _____
TOTAL _____

70
60
50
40
30
20
10
KEY SPP
#2

YR. _____
TOTAL _____

70
60
50
40
30
20
10
KEY SPP
#3

YR. _____
TOTAL _____

THE COMBINATION METHOD

The combination procedure utilizes the most vital elements of the nested frequency and nested density-characterization methods already presented. Although methodology is largely unchanged, there are some significant modifications. As a result, the data forms are somewhat different. Copies of the appropriate data forms are included in the appendix. The procedure to be used is briefly outlined in the following sections.

1. The nested frequency method will be used as indicated in the Forest Service manual except that:

- a. The "close-up" photo of the 3' x 3' plot centered on the 5' mark of the baseline is eliminated. Other close-up photos will be taken on the nested density plots.

- b. The shrub density portion of the method is dispensed with. Shrub density counts will be made on the nested density plots.

- c. Spaces on the data form are provided for ALPHA and NUMERIC codes of each plant species encountered. This will facilitate computer processing of the data. In addition, the frequency worksheet has been considerably simplified and no computations of any kind are necessary. A computer can more efficiently do the summarizing. Note that the nested frequency data worksheet also serves as a data entry form for automatic data processing. Each sampling belt requires one form. The ground cover data on the left side of the form is later transferred to a separate data entry form.

- d. The columns on the Nested Frequency Summary Worksheet entitled "Species Desirability" and "Allowable Occurrences" will not be used unless site-specific scorecards are available as part of a defined management objective for the site.

2. The BLM nested density-characterization method will be employed with the following changes:

a. A comparison of the data form used by the BLM with that employed on the combination procedure will reveal that they are markedly different. The administrative portion at the top has been changed as well as the data portion.

b. A numeric code peculiar to each plant species is recorded. Codes can be found in the Interagency Range Trend Study Species List.

c. Herbaceous plants are treated quite differently. Columns 15-18 from BLM Form 4412-27 are deleted because none of this information is collected with the combination procedure. Individual plants within each species are grouped into age class categories. Beyond that, each age class is graded according to the average height, crown diameter and vigor for the species.

d. Shrubs and trees are given special attention. With the combination method, all individual plants are placed in distinct age, form and vigor classes. The scorecards for age and form class also differ somewhat from that found in BLM instructions. Most importantly, form class is a composite of availability and hedging. Age-class criteria for shrubs are also different from that applied to herbaceous plants. Another change is that average height and crown diameter are recorded for each age-class within a species rather than for the species as a whole within a given plot.

A more detailed explanation of the nested density-characterization portion of the study method follows:

The second part of the Interagency Range Trend Procedure is designed to complement the nested frequency procedure already discussed. The most serious shortcoming of frequency sampling is that it provides no absolute estimates of plant abundance; the use of density plots is intended to correct this problem. In addition, plant characterization data is collected on selected parameters which should be useful for trend assessment. Particular emphasis is given to shrubs and trees. Age and Form class structure of this vegetative component is perhaps the best "predictor" of trend available. The procedure outlined in the following pages is adapted from a trend monitoring method developed by the Bureau of Land Management.

Plot Information. In most cases, three permanent nested plots marked by angle iron stakes or a steel fencepost will be used. These are to be located immediately adjacent to the frequency transect and always within the same habitat type. Be sure also that each plot is accurately documented on the trend study location form. Several plot arrangements are acceptable and these are depicted in Figure 1. Some common sense judgment will be essential in locating plots. Normally, plots will be located 100 ft apart on a line; however, this distance is not an ironclad rule. Plot locations may vary somewhat so as to ensure that some individuals of key species are included.

Plot size can vary. The most common arrangement will likely be a 9.6^2 ft circular plot (Quadrat) nested within a larger 8.3 ft radius plot (1/200 acre). A premeasured chain, rope, cable, etc., can be used for the larger plot. The smaller plot is to be used for characterizing and counting grasses and forbs and the larger for shrubs and trees. On range types, where vegetation is more sparse (i.e., desert shrub, pinyon-juniper), it may be necessary to use larger plots. In this case, a 11.7 ft radius plot (1/100 acre) can be used for shrubs. Square 3 x 3 or 5 x 5 foot frames can also be used for forbs and grasses. If a square plot is used as the nested plot, two

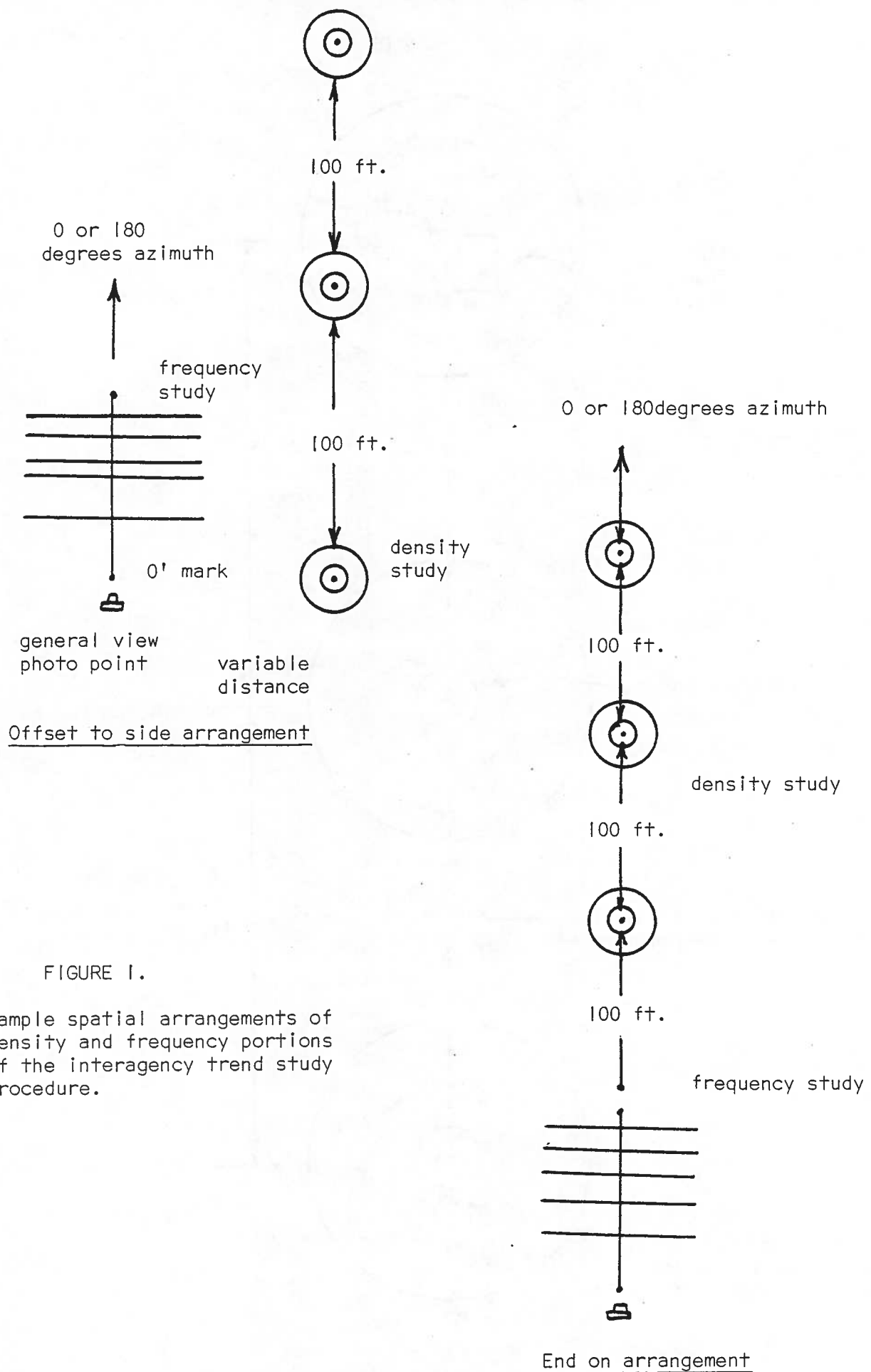
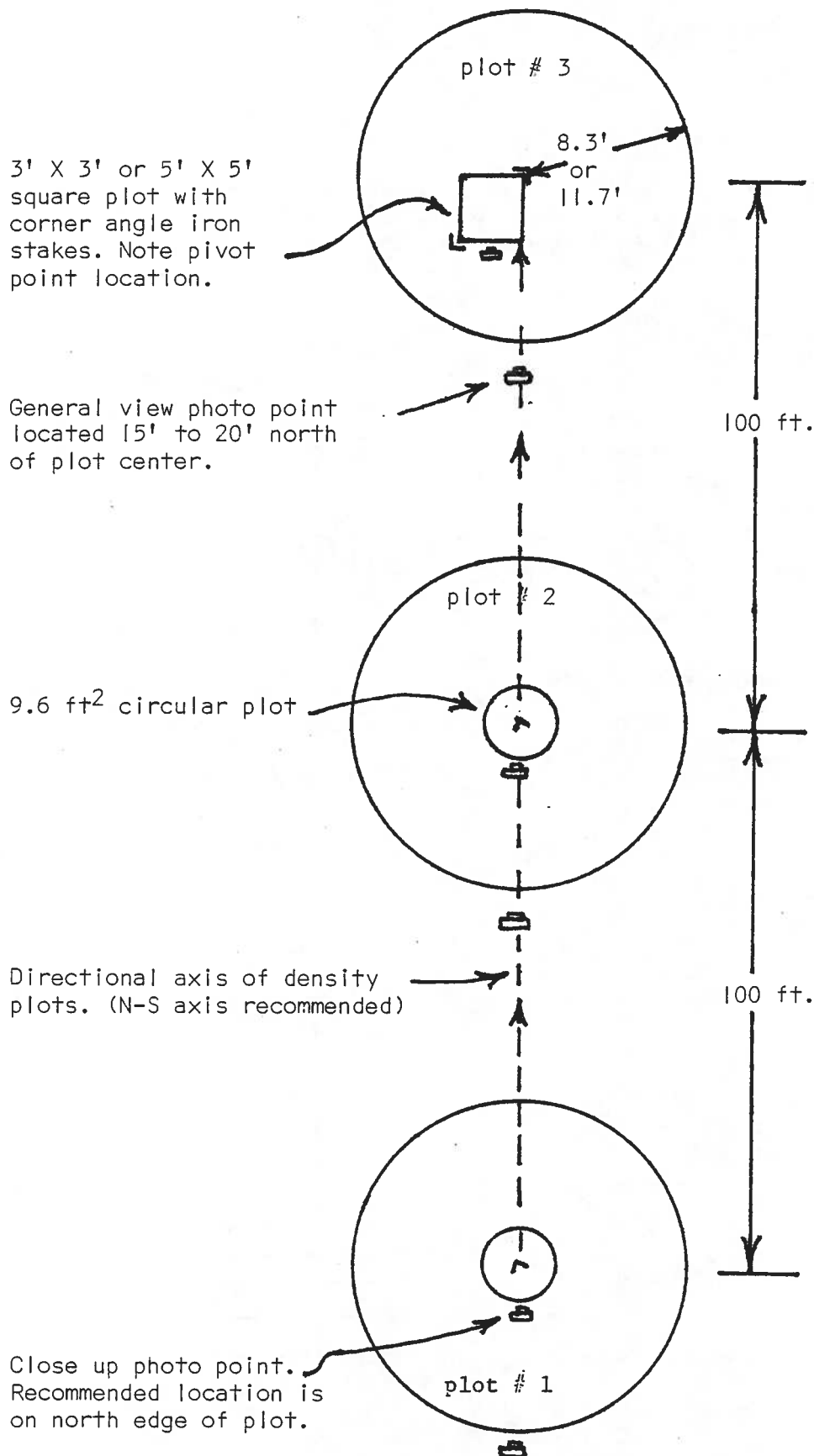


FIGURE 1.

Sample spatial arrangements of density and frequency portions of the interagency trend study procedure.

FIGURE 2

DENSITY PLOT DETAIL



permanent corner markers will be necessary instead of one. Angle iron stakes are best for this purpose but concrete reinforcing rod or fenceposts can also be used. When square plots are employed, the corner marker farthest from the photo point should be used as the pivot for the macroplot. See Figure 2 for a diagram of plots. Whenever possible, align density plots and the frequency baseline on a North-South axis, so that shadows can be avoided in the photographs. Photo points should be located at the north edge of the grass and forb plot.

Setting up the Study. Since the combination procedure is comprised of two rather distinct parts, the question arises: How are the two parts located with respect to each other? A variety of physical arrangements is possible as long as they meet the basic requirement that both frequency and density portions of the study fall clearly within the boundaries of the homogenous range type selected for study. Figure 1 diagrams several potential arrangements of plots, etc. It is necessary, of course, that the layout used be accurately documented and diagrammed in the Trend Study Location Form.

Data Collection. Once a plot center is established or plot corners in the case of square plots, the data can be collected. The initial step is to place the selected frame for the nested plot on the ground. Step 2 will be to take a close-up photograph of the plot from just outside the plot edge. This point should be identified by a steel rebar and should be located on the north side of the plot. A general view photo to encompass the shrub macroplot looking toward the other two plots is also recommended. The photo point should be located on the line of travel, 15 to 20 feet from the plot center. Normally this point will be north of the plot center if the line of density plots is aligned on a N-S axis. we also recommend that a camera with a wide angle lens (28mm-35mm) be employed and that a small stepladder or similar platform be

used to get the photographer well above the photo plot. As with the overall view of the frequency study, color print film is recommended. All photographs should be appropriately identified. We have found that black construction paper with identifying information written with white chalk works well. This material is also easily portable. Once photographs have been taken, the quantitative data can then be collected. The actual reading of the plot is quite simple. Perhaps the best way to explain it is to discuss the data forms.

The nested density worksheet is composed of two parts. The first form contains the necessary administrative and reference information as well as the data sections for grasses and forbs. The second form is similar, but deals with shrubs and trees. Sample completed copies of the worksheets are attached.

Reference Section. Most of this is self-explanatory. There are, however, some exceptions:

Trend study #: Trend studies should be numbered consecutively within herd units. For example, the third study to be established on a given herd unit in 1982 would be numbered 3-82.

Range type: Gambel Oakbrush, Big Sagebrush Grass, etc.,--a list of these and their numeric codes is in the appendix. Others can be added as needed.

of plots: Most trend studies will have 3 density plots. Occasionally, however, there may be circumstances where more or less are required.

Plot size: The standard size for forbs and grasses is a 9.6 ft^2 circular plot. This is to be centered over the permanent plot marker. Square (3' x 3' or 5' x 5') nested plots can also be used. For shrubs and trees, 8.3 ft (1/200 acres) and 11.7 ft (1/100 acre) radius plots can be used depending on the character of the vegetation.

Azimuth, plot
1 to 3: Record the compass azimuth in true degrees or mils from density plot 1 to plot 3.

Grasses and Forbs. Plot numbers (i.e., 1-3) are recorded in the left hand column. The species ALPHA and NUMERIC codes for each species encountered in the plot are recorded in the next two columns. Species should be recorded with the correct symbol and numeric code as listed in the Range Trend Species List. Careful recording of these codes saves much editing when the data are processed at a later date. A dot count of individuals within each grass and forb species and age class is recorded in the next four columns. The total count of individuals for each species is listed at the far right of the form. Average height, crown diameter and vigor for each age class are recorded in the remaining columns. Vigor codes are recorded according to the scorecard presented later in this handbook. The total count of grasses and forbs (of all species encountered) is tallied at the bottom of the form. Do not count or characterize annual plants. These, if present, should be identified and their relative abundance, etc., assessed in the remarks section.

Shrubs and Trees. This vegetative component is handled differently since they are such sensitive trend predictors. In this section, individuals of each species are placed in the various age and form class combinations using a

dot count, which is then totaled when the plot is completed. Height and crown diameter estimates are recorded for each age-class represented. A check for recording errors is to compare the dot count between form and vigor classes for each species. These should be the same. Subtotals are compiled across rows and down columns for each species to provide form, age and vigor class totals.

Summary and Analysis. After the field data forms are correctly filled out for all portions of the study, it remains to return to the office and prepare the data for computer processing. Copies of the appropriate dataentry forms are included in the appendix. These forms are organized so that the pertinent information can easily be keypunched. Four record types, designated 1 through 4 in column 80 are utilized to enter frequency, cover, grass and forb density/characterization and browse density/characterization respectively.

Record type 1: Note that for this record type, the field data form is also the form for keypunching. The only parts of this form needing further explanation are the columns labelled VEG TYPE and the box on the left side for recording ground cover hits. VEG TYPE will be either G (grass), F (forb) or B (browse). Ground cover should be dot counted and when the belt is, complete the number of dots in each category written down within the block. be certain that the total equals 80.

Record type 2: This record type is where the ground cover data is recorded. Each study requires one horizontal line or ADP card. The number of cover hits in each category are totaled among the 5 belts and entered. Check to be sure that the total number of hits entered equals 400.

Record type 3: Grass and forb density/characterization data are entered on this form. The first 19 columns and the species ALPHA and NUMERIC codes are self explanatory. plot size should be entered as either 0090, 0096 or 0250 to represent the area in square feet of the plot used. Vegetation type is entered as either G or F. The remaining columns are taken directly from the density worksheet for each plot number/age class combination

Record type 4: Record type 4 is used to enter data on browse density and characterization. Note that each age class/plot number combination within a species requires a separate line or record on the dataentry form.

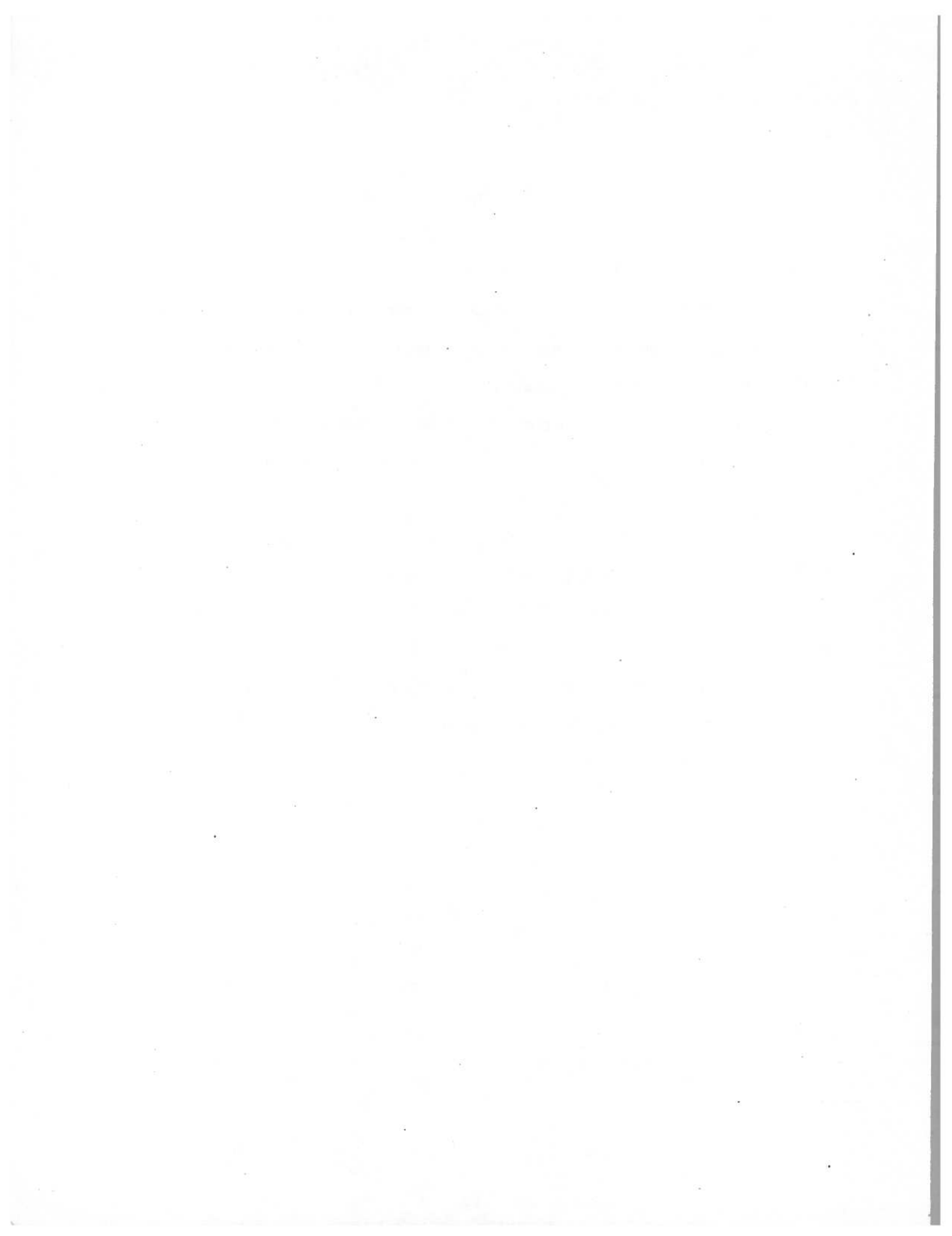
Once the raw data has been correctly entered and punched, a computer program exists at the Salt Lake City office of the DWR to select best plot sizes, number of occurrences, percent composition by species and other computed parameters for a summary report. The analysis of variance described in the Forest Service Manual can also be done in this manner when two or more readings of the same study are available. or when data from a suitable "comparison area" is available. Statistical testing of the density data can also be accomplished through computer programs. From these summaries and tests an assessment of trend relative to the management objective can be made.

APPARENT TREND EVALUATION

The apparent trend evaluation is designed to provide land managers with a preliminary assessment of range trend on a given site. It is particularly important when statistical comparisons from the more formalized study procedure are not yet available. The evaluation is based on a combination of the observer's subjective judgments about a site and preliminary analysis of the data collected on the nested frequency and density plots. Because of the latter requirement, the apparent trend evaluation should be done only after data from the nested plots have been collected and summarized. The first step in doing an evaluation, will be for the observer(s) to make brief walk or reconnaissance through the study area and make note of personal observations site conditions and various trend indicators. This information will then be tempered by any outstanding indications or predictors of trend that can be gleaned from a preliminary look at results from the nested plots. An Apparent Trend Evaluation Form is provided to aid the observer in knowing what to look for. In addition, a short narrative about the site should be prepared. Instructions for the narrative are provided in the following section and an example of the narrative form can be found in the appendix. The narrative, in combination with the apparent trend rating form should assist in making an overall trend assessment for the site. The person making the assessment must, of course, have an appreciation of the management objective.

STUDY SITE NARRATIVE GUIDELINES

Evaluation of trend on individual sites depends essentially on two components. Obviously, one of these is the data collected and the various ways it can be manipulated, analyzed and displayed. The second component is equally important. It requires the personal, sometimes objective observations of the person or persons conducting the study. There is really no substitute for careful on-site impressions of an experienced land manager or observer. The attached guidelines are an attempt to provide a checklist of some of the items which should be noted and written about. You may temper, qualify or reinforce your observations by a preliminary assessment of the collected data but remember that it is your carefully considered impressions that are the important item here. Each time a study is established or read it is important that a short narrative be prepared. Do not be concerned that your narrative is too long or too subjective. A two page form is provided but do not hesitate to use extra paper if necessary.



APPARENT TREND EVALUATION

Deer Herd Unit _____ Study Site Name _____ Trend Study # _____

Habitat Type _____ Date _____ Observer(s) _____

VEGETATION 1/

Apparent Trend		
Up	Stable	Down
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

Age class distribution of key species

Age class distribution of invader or increaser species

Form and vigor of key species

Plant composition

Obvious ecological signs

SOIL

Up or Stable

Down

1. Ground cover dispersion - uniform. _____
2. No detectable soil movement. _____
3. Soil cover 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. _____

1. Ground cover dispersion - variable to highly variable. _____
2. Soil movement detectable. _____
3. Soil Cover broken and soil exposed. _____
4. Plant roots exposed. 1/ _____
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. _____

1/ At high elevations and on heavy soils some of this may be natural due to frost heaving.

Remarks _____

Overall Vegetative trend _____

Overall Soil Trend _____

1/ See back of form for explanation and instructions for use of this form.

Age class-- An important parameter. In stable populations, the number of seedlings and young plants should equal or slightly exceed the number of decadent plants. Expanding or declining populations will be skewed towards either extreme. With respect to invader or increaser species, an expanding population might be an indicator of downward trend, however this could vary depending on the management objective.

Form class and vigor -- For most key species, it is desirable to have a preponderance of plants in form classes 1 and 2 and in vigor class 1. Any significant deviation that would indicate either heavy utilization, decreased availability, or poor plant vigor are trend predictors.

Plant composition -- Pay attention to the relative mix of forbs, shrubs, and grasses and also the mix of desirable, intermediate, and least desirable species within each group. If a particular species is known to be especially aggressive and/or competitive make note of this in the remarks section.

Obvious ecological signs -- Look for evidence of certain ecological and successional processes. For instance, aspen to conifer succession, juniper invasion, or reinvasion by sagebrush of sprayed or seeded sites. Tree canopy closure and resultant loss of light may adversely affect a key understory species.

Remarks -- Use this section of pertinent or necessary explanations of ratings.

Overall ratings -- These should be based on the various trend elements. Some judgement will be required. Include a short explanation.

STUDY SITE NARRATIVE

PHYSICAL FACTORS - (Slope, aspect, elevation, precipitation, fire, distance to water etc.)

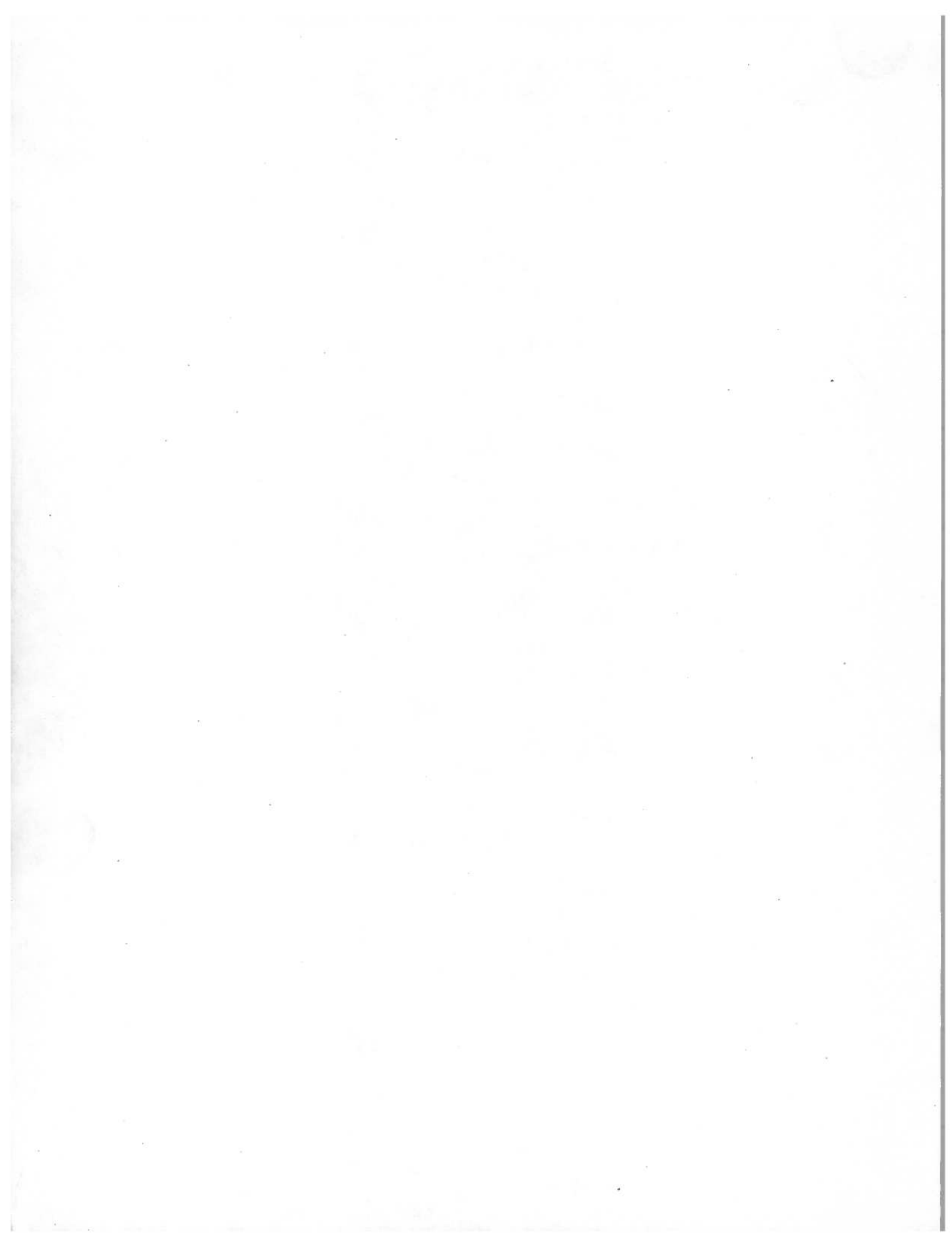
SOIL - (Apparent depth, texture, color hardpan, alkali deposits, soil surface character, erosion, sedimentation, organic matter, compaction, are soil exposed, litter, vegetative cover, etc.)

PLANT COMPOSITION - (Dominant overstory & understory, height, availability, preference & palatability, abundance, density, potential or designated key species, age structure, form class, intensity of animal use of important species, vigor, insects and disease, unique or rare species)

ANIMAL USE - (Big game, livestock, seasonality & intensity of use, antler drops, pellet groups, resting, foraging, escape cover, thermal cover, etc., other wildlife use)

OTHER LAND USE - (Minerals, energy, timber, summer homes, roads, people pressure, etc.)

APPENDIX



NUMERIC CODES FOR RANGE AND LAND USE TYPES

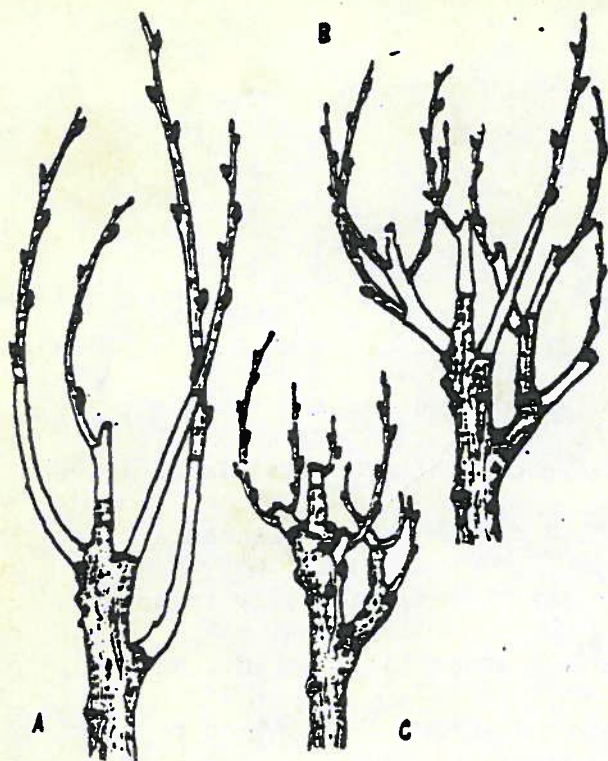
The following codes are to be utilized for data entry purposes
and for mapping purposes.

<u>CODE</u>	<u>DESCRIPTION</u>	<u>CODE</u>	<u>DESCRIPTION</u>
01	Juniper	42	Perennial Forb
02	Juniper-Pinyon	43	Wet Meadow
03	Pinyon	44	Dry Meadow
04	Pinyon-Juniper	45	Alpine Grass
05	Big Sagebrush	46	Alpine Forb
06	Big Sagebrush-Grass	47	Alpine Shrub
07	Low Sagebrush	48	Alpine-Mixed
08	Black Sagebrush	49	Riparian habitat-Grass, Forb
09	Sand Sagebrush	50	Riparian habitat-Shrub
10	Fringed Sagebrush	51	Riparian habitat-Broadleaf Tree
11	Bud Sage	52	Riparian habitat-Coniferous
12	Rubber Rabbitbrush	53	Douglas Fir-White Fir
13	Small Rabbitbrush	54	Limber Pine
14	Snakeweed	55	Lodgepole Pine
15	Black Greasewood	56	Ponderosa Pine
16	Winterfat	57	Bristlecone Pine
17	Shadscale	58	Engelmann Spruce-Alpine Fir
18	Mat Saltbush	59	Quaking Aspen
19	Castle Valley Clover	60	Mixed Broadleaf Trees
20	Fourwing Saltbush	61	Selective logged-Subalpine Forest
21	Hopsage	62	Selective logged-Ponderosa Pine
22	Mixed Salt desert Shrub	63	Selective logged-Mixed Conifer
23	Burrobrush	64	Clearcut-Subalpine Forest
24	Creosote Bush	65	Clearcut-Ponderosa Pine
25	Blackbrush	66	Clearcut-Mixed Conifer
26	Mixed Southern Desert Shrub	67	Clearcut-Aspen
27	Ephedra-Dalea	68	Chained, Cabled-Reseeded P-J
28	Gambel Oakbrush	69	Chained, Railed-Shrubland
29	Mixed Oak-Sage	70	Sprayed shrubland
30	Shrub Live Oak	71	Agricultural-Pasture
31	Wavy Leaf Oak	72	Agricultural-Cropland
32	Snowberry	73	Agricultural-Hay Meadow
33	Serviceberry	74	Rural-Residential
34	Bitterbrush	75	Rural-Industrial, Commercial
35	Manzanita	76	Urban-Residential
36	True Mtn. Mahogany	77	Urban-Industrial, Commercial
37	Curlleaf Mtn. Mahogany	78	Mining Activity
38	Stansbury Cliffrose	79	Oil & Gas Activity
39	Annual Grass	80	Lake or Reservoir
40	Perennial Grass	81	Barren
41	Annual Forb	82	Mixed Mountain Brush

AGE CLASS*

<u>Code number</u>	<u>Grasses</u>	<u>Forbs</u>
S-seedling	Must be an established plant base less than 1/4" diameter	Must be an established plant base less than 1/4" diameter
Y-young	Base 1/4" to 1" diameter (usually minimum flowering)	Base 1/4" to 1" diameter (may flower and seed sparingly)
M-mature	Flowers and produces fruits Base larger than 1" diameter, Rhizominous species usually have produced 1 or more sprouts.	(Same)
D-decadent	Over 25% of crown dead (do not include dead material from previous year's growth)	(Same)

*Applies only to perennial species, annuals are not counted. Important biennial species such as sweet clover etc., should be classed as young when in the basal rosette stage, plants with fruiting stalks are mature.



FORM CLASS

1. All available, lightly hedged.
2. All available, moderately hedged.
3. All available, heavily hedged.
4. Largely available, lightly hedged.
5. Largely available, moderately hedged.
6. Largely available, heavily hedged.
7. Mostly unavailable.
8. Unavailable due to height.
9. Unavailable due to hedging.

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

Lightly hedged: 0 to 40 percent of twigs browsed.

Moderately hedged: 41 to 60 percent of twigs browsed.

Heavily hedged: Over 60 percent of twigs browsed. Degree of hedging is based on leader use over the past three years; current annual growth is not included.

Largely available: One-third to two-thirds of plant available is animal.

Mostly available: Less than one-third of plant available. In classifying browse for form class, unavailability may be the result of height, location, or density.

AGE CLASS

S = Seedling Y = Young plant M = Mature plant D = Decadent plant

Seedling: Plant up to three years old which has become firmly established, usually less than 1/8-inch diameter.

Young plant: Larger, with more complex branching and more fibrous bark than seedling, does not show signs of maturity. Usually between 1/8- and 1/5-inch diameter.

Mature plant: Complex branching, rounded growth form, larger size. Seed is produced on healthy plants. Generally larger than 1/4-inch diameter.

Decadent plant: Plant, regardless of age, that is in a state of decline, usually evidenced by 25 percent or more dead branches.

VIGOR CLASS

Code number

- | | |
|---|---|
| 1 | Normal & vigorous |
| 2 | Insect infested or diseased |
| 3 | Poor vigor - chlorotic or discolored leaves,
smaller than normal stem or leaves,
flowering restricted, partially trampled,
pulled up, or otherwise damaged. Stunted
growth, partial crown death, (not to be
confused with normal seasonal crown diebacks
or leaf drop.) |
| 4 | Dying - substantial portion of crown dead
(more than 50%), more extreme than 3 above.
Probably an irreversible condition. |

EQUIPMENT NEEDS

The materials listed below are for one 2 man crew to do 1 study. The list is complete and should cover all plot sizes which may be used.

<u>Number</u>	<u>Item</u>
2	100 ft. tapes with 1 ft. graduations
4	Anchoring posts (T bars) for securing tape ends
1	4 lb. sledgehammer
5	"T" fenceposts or angle iron posts (3 ft. minimum)
1	Nested frequency frame
1	Clipboard or tatum holder
1	Compass
1	Interagency Range Trend Study Manual
1	Plant species list with alpha-numeric codes
var	Plant identification aids
1	Quadrat frame (9.6 ft ² circular)
1	Quadrat frame (3' x 3' square)
1	Quadrat frame (5' x 5' square)
1	Chain or rope etc., 8.3 ft. length
1	Chain or rope etc., 11.7 ft. length
var	Appropriate data forms
var	Pen and Pencils
1	Camera and color print film
1	Small chalkboard or ID forms for photographs
1	Chalkboard holder
1	Meter stick, cm. graduated
1	Small stepladder or platfrom for photographs
1	Map or aerial photo

NESTED DENSITY - CHARACTERIZATION WORKSHEET
(Grasses and Forbs)

Deer Herd Unit _____ Study Site Name _____ Land Ownership _____ Trend Study # _____ Range Type _____ Date _____
 Date Study Established _____ Observers _____ Number of Plots _____
 Interval(s) between plot centers _____ Azimuth, plot 1 to 3 _____ Plot Size _____

[illegible]

[illegible]

Remarks--(uncounted annuals, # of dead plants, utilization etc.)

NESTED DENSITY - CHARACTERIZATION WORKSHEET
(Shrubs)

Deer Herd Unit _____ Study Site Name _____ Trend Study # _____ Date _____
 Range Type _____ Date Established _____ Land Ownership _____
 Observers _____ # of Plots _____ Plot Size _____
 Interval(s) between plot centers _____ Azimuth, plot 1 to 3 _____

Plot no.	Species Code (shrubs)	Numeric Code	Age Class	Form Class										Vigor Class				Tot. no.	Avg. Ht. (cm)	Avg. Crown Diam.
				1	2	3	4	5	6	7	8	9	1	2	3	4				
			S																	
			Y																	
			M																	
			D																	
Species Subtotal(all ages)																				
			S																	
			Y																	
			M																	
			D																	
Species Subtotal(all ages)																				
			S																	
			Y																	
			M																	
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Species Subtotal(all ages)																				
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Species Subtotal(all ages)																				
			S																	
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			D																	
Species Subtotal(all ages)																				
			S																	
			Y																	
			M																	
			D																	
Species Subtotal(all ages)																				

(CONTINUED ON BACK)

Plot no.	Species Code	Numeric Code	Age Class	Form Class									Vigor Class				Tot. no.	Avg. Ht.	Avg. Crown Diam.
				1	2	3	4	5	6	7	8	9	1	2	3	4			
			S																
			Y																
			M																
			D																
Species Subtotal(all ages)																			
			S																
			Y																
			M																
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Species Subtotal(all ages)																			
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Species Subtotal(all ages)																			
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			D																
Species Subtotal(all ages)																			
			S																
			Y																
			M																
			D																
Species Subtotal(all ages)																			

[illegible]

HERD UNIT	STUDY NUMBER (1-50)	DATE READ 8, 9, 10, 11, 12, 13, 14, 15	RANGE TYPE (11-20)	PLOT SIZE	VEG. TYPE	SPECIES ALPHA CODE (21-30)	SPECIES NUMERIC CODE (31-40)	PLOT NUMBER	AGE CLASS	AVERAGE VIGOR	AVERAGE HEIGHT (41-50)	AVERAGE CROWN DIAMETER	TOTAL NUMBER (51-60)	DB RECORD TYPE
1	1	8	1	9	1	1	1	1	1	1	1	1	1	0
2	2	9	2	10	2	2	2	2	2	2	2	2	2	1
3	3	10	3	11	3	3	3	3	3	3	3	3	3	2
4	4	11	4	12	4	4	4	4	4	4	4	4	4	3
5	5	12	5	13	5	5	5	5	5	5	5	5	5	4
6	6	13	6	14	6	6	6	6	6	6	6	6	6	5
7	7	14	7	15	7	7	7	7	7	7	7	7	7	6
8	8	15	8	16	8	8	8	8	8	8	8	8	8	7
9	9	16	9	17	9	9	9	9	9	9	9	9	9	8
10	10	17	10	18	10	10	10	10	10	10	10	10	10	9
11	11	18	11	19	11	11	11	11	11	11	11	11	11	10
12	12	19	12	20	12	12	12	12	12	12	12	12	12	11
13	13	20	13	21	13	13	13	13	13	13	13	13	13	12
14	14	21	14	22	14	14	14	14	14	14	14	14	14	13
15	15	22	15	23	15	15	15	15	15	15	15	15	15	14
16	16	23	16	24	16	16	16	16	16	16	16	16	16	15
17	17	24	17	25	17	17	17	17	17	17	17	17	17	16
18	18	25	18	26	18	18	18	18	18	18	18	18	18	17
19	19	26	19	27	19	19	19	19	19	19	19	19	19	18
20	20	27	20	28	20	20	20	20	20	20	20	20	20	19
21	21	28	21	29	21	21	21	21	21	21	21	21	21	20
22	22	29	22	30	22	22	22	22	22	22	22	22	22	21
23	23	30	23	31	23	23	23	23	23	23	23	23	23	22
24	24	31	24	32	24	24	24	24	24	24	24	24	24	23
25	25	32	25	33	25	25	25	25	25	25	25	25	25	24
26	26	33	26	34	26	26	26	26	26	26	26	26	26	25
27	27	34	27	35	27	27	27	27	27	27	27	27	27	26
28	28	35	28	36	28	28	28	28	28	28	28	28	28	27
29	29	36	29	37	29	29	29	29	29	29	29	29	29	28
30	30	37	30	38	30	30	30	30	30	30	30	30	30	29
31	31	38	31	39	31	31	31	31	31	31	31	31	31	30
32	32	39	32	40										

(KEY PUNCHING INSTRUCTIONS)

The above fields to be repeated

[illegible]

