TECHNICAL NOTE

USDA NATURAL RESOURCES CONSERVATION SERVICE HAWAII

Grazing Technical Note - No. 1

METHODS FOR DETERMINING THE CROWN CANOPY OF SHRUBS AND TREES

This coversheet transmits an a technical note originally released by the West National Technical Center (WNTC) in September 1986.

The technical note describes several methods available for measuring crown caopy of shtrubs and trees which may be used as an aid to field personnel engaged in various kinds of resource inventories on rangeland.

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SUBJECT: ECS - RANGE - METHODS FOR DETERMINING THE CROWN CANOPY OF SHRUBS AND TREES

Purpose. To transmit the above named technical note.

Effective Date. When received.

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Filing Instructions. File in Technical Note binder under Range section.

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Attachment

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METHODS FOR DETERMINING THE CROWN CANOPY OF SHRUBS AND TREES

There are several methods available for measuring crown canopy of shrubs and trees. Each method must be considered in terms of type of vegetation studied, time needed to make a particular determination, and accuracy of the method. This information is presented as an aid to field personnel engaged in various kinds of resource inventories on rangeland.

Line Intercept Method

This method is commonly used for measuring plant composition and crown cover for both shrubs and trees. It consists of recording the horizontal linear measurements of plants along a line. In this case, only shrubs and/or trees are considered. Plant intercepts of shrubs and tree canopy along a 100-foot tape are measured, and the total of the intercepts is accepted as the percentage of ground surface covered by the plants. Then the canopy cover of individual species or groups of species are expressed as a percentage of the whole line. A line of 100 or more feet is used in sparce vegetation and short lines (50 feet) are commonly used in dense cover. In dense cover, the tape is suspended above the shrubs.

This method is best suited on grass-shrub types of vegetation and clear definitions of what constitutes a plant crown, such as the size of interstices within a plant. The method is fast and accurate and reasonably free of bias.

Step Point Method

Also known as pace transect, it consists of recording the species encountered under certain points selected by pacing across an area of vegetation. The examiner makes a "point" or mark on the tip of one shoe sole. He then selects a course, preferably a straight line, which will take him through an average or representative part of a selected plant community. A transect often consists of 100 paces. To measure shrub cover, a "hit" is considered any point covered by shrub canopy, looking vertically down on the shrub.

The technique is most suitable for measuring major characteristics of vegetation of an area. It is a rapid method and reasonably accurate.

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Zig-Zag Transect

A modified technique of the forester's zig-zag transect can be used to determine both shrub and tree canopy. The type of transect is the same one used by the foresters for measuring site indexes for pinyon-juniper and other trees. (Refer to Woodland Tech Note No. 13.) This method was adapted from Colorado Range Note No. 27.

1. Determine, before starting, what shrub or tree will be inventoried. It may be used for one species or several species may be added together.

2. Choose a direction of travel which will take you through the stand in order to see a good cross section of it. Go toward a visible landmark and maintain the same general direction of travel.

3. Select a starter shrub or tree which is part of the stand to be measured. No measurements are made of the starter plant, it serves only as a starting point. Suppose big sagebrush is selected to determine the crown canopy, at the base of the starter shrub face the chosen direction, place heels together with feet making a 90° angle (figure 1). Locate the next closest shrub, the center of which is within the angle defined by your feet. This is shrub #1. If more than one shrub falls within the 90° angle, choose the one closest to the direction of travel.

4. Measure the distance from the center of the starter shrub to the center of shrub #1 and the diameter of the first shrub, by chaining or by pacing. Record the distance and diameter on the inventory sheet (exhibit 1). Standing at shrub #1, repeat steps previously described to select and measure shrub #2. Continue in this manner until a minimum of 20 shrubs have been measured. The form provides for 100 shrubs. The line of travel should be in a zig-zag fashion as shown in figure 1.

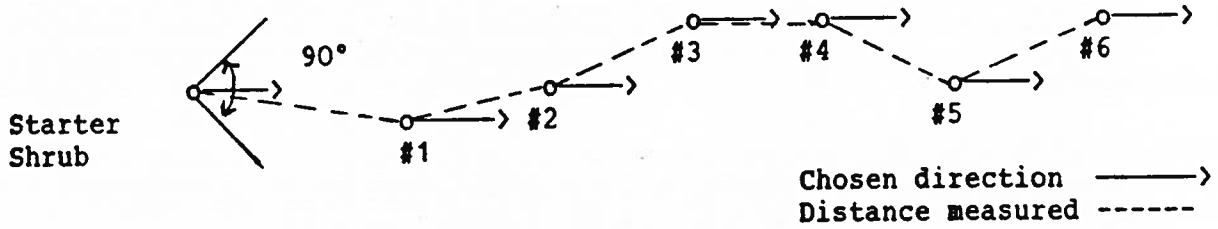


Figure 1. Sequence of shrub and rules of selection.

5. Skipover openings and clumps or patches of shrubs not part of the main stand. Do not include shrubs or trees on the edges of openings or clumps. Pass through them on the chosen direction of travel and begin measurements on the opposite side.

To Determine Percent Crown Canopy

Follow the following procedure:

1. After running the zig-zag transect and recording data on the form (exhibit 1), total the column for spacing and divide the number of plants sampled to get the average spacing.

2. Repeat this procedure for the crown diameter (feet) and enter the average crown diameter in the space provided on exhibit 1.

3. To find percent of canopy cover use one of two procedures.

Procedure 1. Refer to exhibit 2. Locate the average spacing on the left side of the graph. Now locate the average crown diameter in feet at the top of the graph. Read down from the top to where the average spacing line intersects the average diameter line. Read diagonally to the right for the percent of canopy cover. In the case where the average spacing line intersects the average diameter line, between the diagonal lines of percent canopy, one must interpolate between the next highest and lowest diagonal lines to read percent canopy.

Procedure 2. By calculation. For example, a 2-foot average diameter plant with an average 3-foot spacing.

a. To determine area of crown:

$A = 3.14r^2$, for a 2-foot diameter plant = $3.14(1)^2$

A = 3.14 sq.ft. average area of plant

b. To determine number of plants per acre:

Sq.ft. per acre ÷ average spacing of plants squared

$43,560 \div 3^2 = 4,840$ plants per acre

c. To determine percent canopy cover per acre:

(1) Average area of plant x number of plants = sq.ft. in acre plant occupies.
3.14 x 4,840 = 15,198 sq.ft. per acre

(2) Sq.ft. in area plant occupies ÷ sq.ft. in acre x 100 = % canopy cover of plants in acre.
15,198 ÷ 43,560 x 100 = 35% canopy cover/acre.

This type of transect has been primarily used for estimating wood production in pinyon-juniper and has not been field tested for range shrub cover. In theory, it is comparable to the line-intercept or fixed-plot method. It has applicability in pinyon-juniper areas.

Fixed Plot Method

This method is commonly used to study vegetation on a more detailed basis, but could be adapted for determining shrub and tree canopy cover. It consists of locating a plot representative of the vegetation, usually from 1/100 to 1/10 acre in size. The crown canopy is measured and/or estimated for each species and tallied for each plant. The percent canopy cover per acre would then be calculated in the same manner as for the zig-zag transect method. One or more plots may be necessary to determine the shrub cover, depending on the uniformity of the cover. It would apply to shrub and pinyon-juniper types.

Photo Interpretation

This method employs the use of aerial photographs to determine woody plant canopy cover. It is reasonably accurate for determining the total shrub and/or tree cover. The major limitation is that photo resolution is usually not sufficient to identify woody plants to species, expecially shrubs.

Range site boundaries can be drawn on aerial maps or taken from soil survey maps. Representative plots of the woody plant cover are then identified and comparison charts for visual estimation of foliage cover are used to determine the total canopy cover. Refer to exhibit 3.

Point Observation Plot (square-foot density)

This is an estimate method where accuracy on each plot is sacrificed for a larger number of sample plots. The crown conopy of each species in a representative plot is estimated, occularly, in square feet. It is necessary that the estimators have a mental concept of how much of the particular species is required for one square foot of vegetation. In training for this concept, a shrub or portion of vegetation is clipped and placed in a square foot frame so that it occupies the frame without distortion. Daily checking of his concept is required by each estimator. The size of the large plot depends on the vegetation. Plot size may range from 25 square feet in dense vegetation to 100 square feet.

This method is rapid to use and is more reliable when the same group of individuals make estimates on all study areas. It has less value when different personnel take data at different times or places. Because the data obtained with this method is subjective, the quality and validity of data is subject to criticism.

Spherical Densiometer

This is a pocket size instrument that is used for measuring forest overstory density. It may have some application on certain range sites with large tree overstory such as ponderosa pine. The instrument consists of a small 2-inch diameter concave or convex mirror divided into 1/4-inch squares. The observer stands in a representative location and holds the instrument level, 12 to 18 inches in front of him at elbow height. He assumes four equi-spaced dots in each square on the grid and systematically counts dots equivalent to quarter-square canopy openings.

The total count is multiplied by 1.04 to obtain percent of overhead area not occupied by canopy. The difference between this and 100 is an estimation of overstory density in percent. (Assuming each dot to represent one percent is often accurate enough.) Four readings are made per location, facing north, east, south, and west, then recorded and averaged to determine total canopy cover. A common error is to count dead limbs instead of foliage, which will bias the answer. The method is rapid and recognized by foresters as an acceptable procedure.

Exhibit #1

SHRUB INVENTORY WORKSHEET

Shrub or Shrubs Measured: _____ Date: _____

Soil Unit Name/Symbol: _____ Location: _____

LRA: _____ Personnel: _____

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

UNDERSTORY VEGETATION

SUMMARY

AVERAGE SPACING _____ FEET

AVERAGE DIAMETER _____ FEET

EXHIBIT No. 2

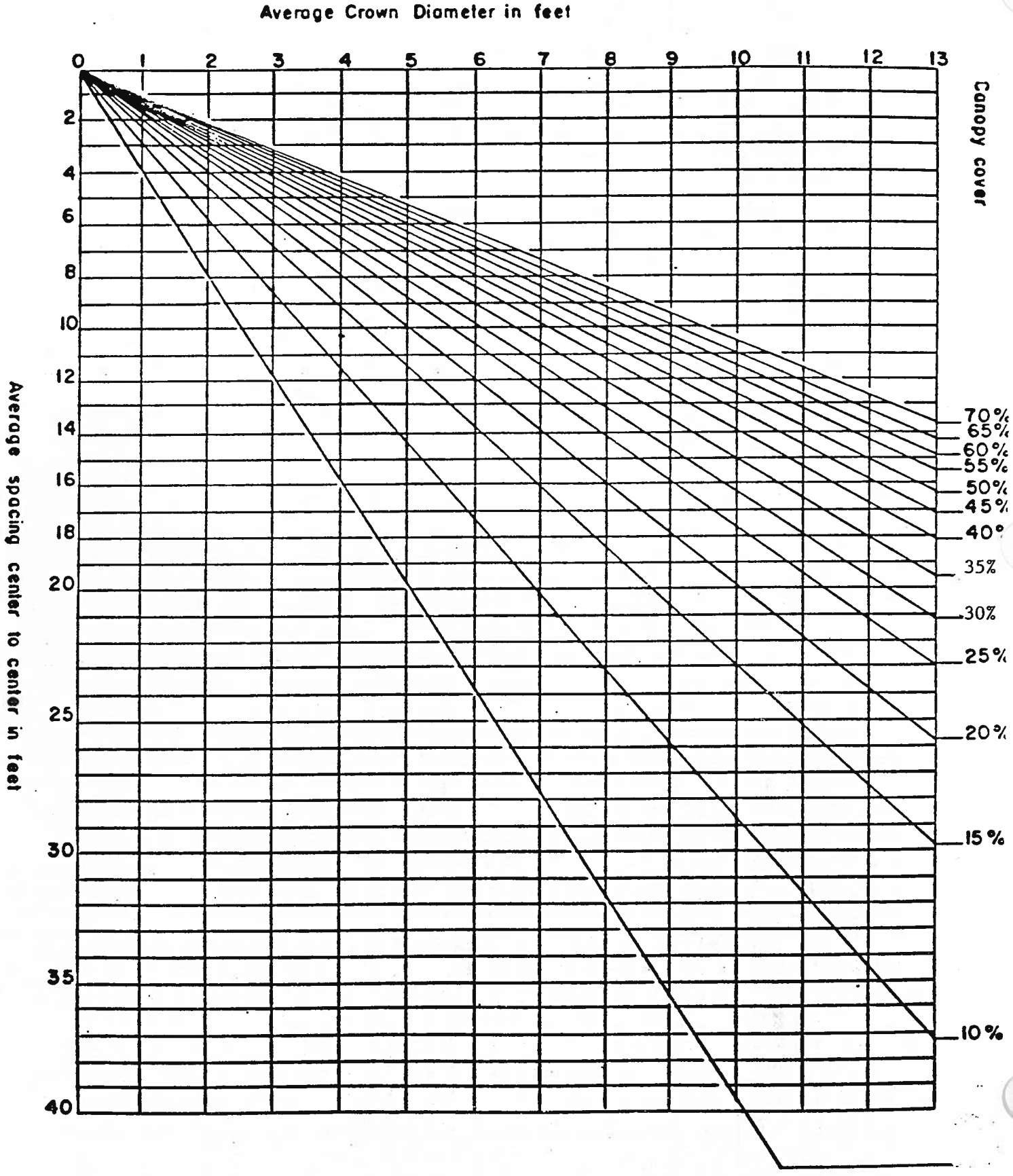
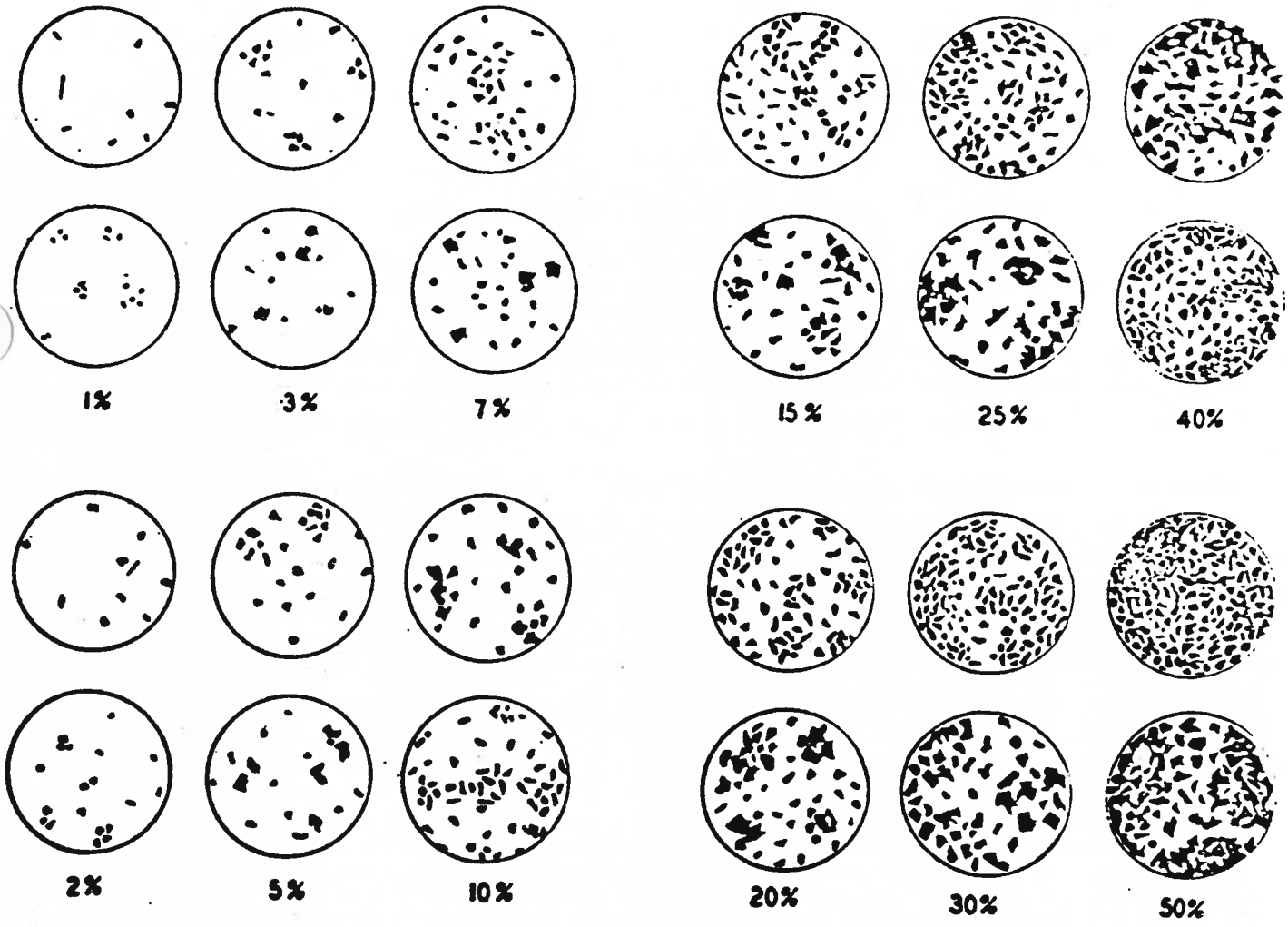

Average Crown Diameter in feet
0 1 2 3 4 5 6 7 8 9 10 11 12 13
Average spacing center to center in feet
2 4 6 8 10 12 14 16 18 20 25 30 35 40
Canopy cover
70%
65%
60%
55%
50%
45%
40%
35%
30%
25%
20%
15%
10%

EXHIBIT NO. 3

COMPARISON CHARTS FOR VISUAL ESTIMATION OF FOLIAGE COVER 1/



1/ Developed by Richard D. Terry and George V. Chilingar. Published by the Society of Economic Paleontologist and Minerologist in its Journal of Sedimentary Petrology 25 (3): 229-234, September 1955.