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# THE DENSIOMETER FOR MEASUREMENT OF CROWN INTERCEPT ABOVE A LINE TRANSECT



by

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An adaptation in the use of Lemmon's spherical densiometer[1/] has been developed to measure low overstory crown foliage as intercept above a line transect. This adaptation provides added information for the evaluation of ecological relationships within and among plant communities where some species are too low for overstory density estimates and too high for direct intercept measurements, e.g., mountain mahogany[2/] (Cercocarpus ledifolius) and western juniper (Juniperus occidentalis).

After the adaptation was developed, tests were made to measure: (1) precision of the method, (2) variation between operators, and (3) time required. Results show that method precision is high, variation between operators is low, and length of time required to make measurements is acceptable for practical field use in central Oregon.

## EQUIPMENT AND PROCEDURES

The densiometer is a gridded convex mirror, mounted in a 3- by 3- by 1-inch box, in which overstory crown foliage is reflected (fig. 1). The center of the third line from the grid boundary closest

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[1/] Lemmon, Paul E. A spherical densiometer for estimating forest overstory density. Forest Sci. 2: 314-320, illus. 1956.

[2/] The name commonly used in the Pacific Northwest for curlleaf cercocarpus.

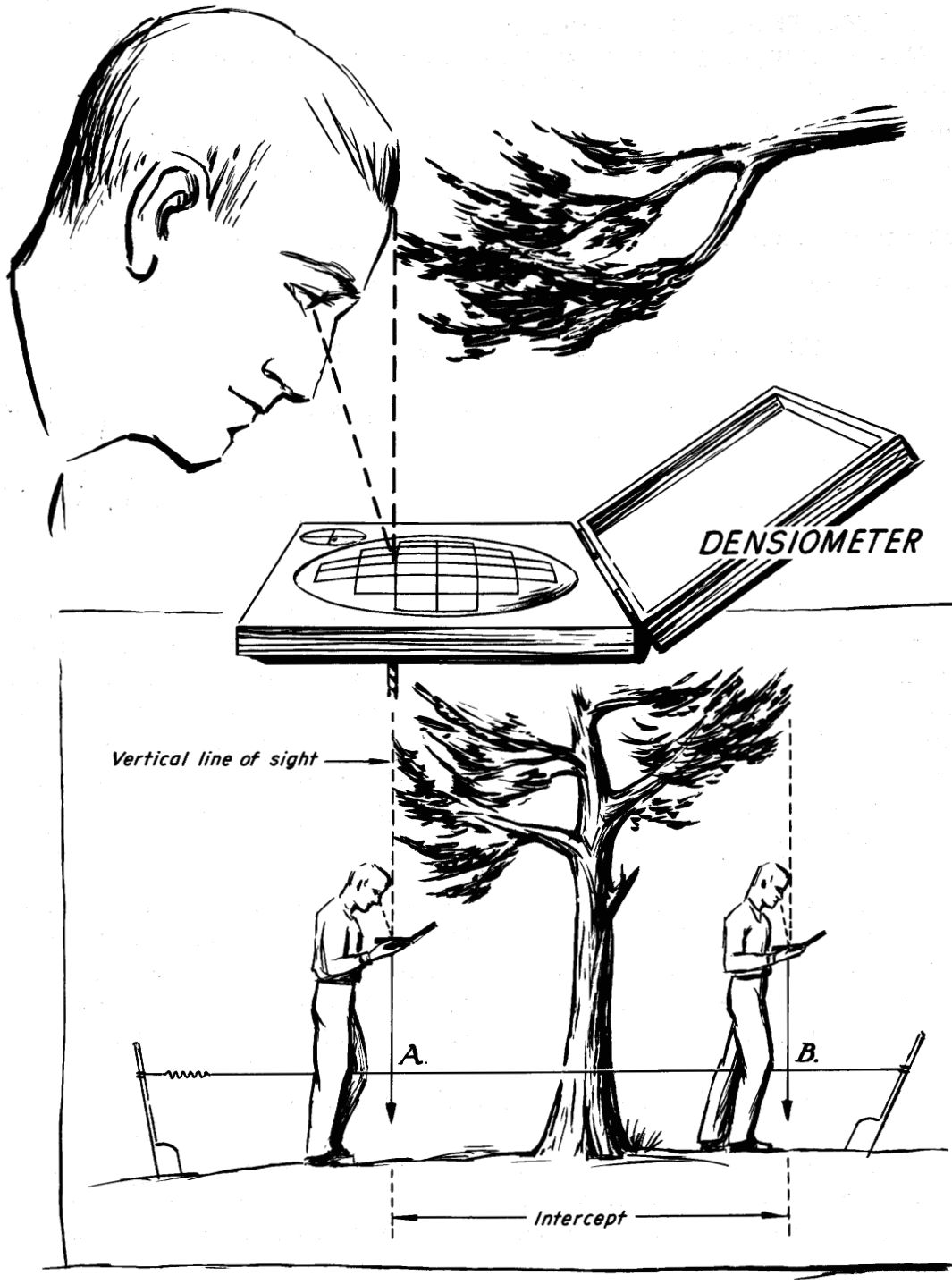


*Figure 1.--Densiometer and relative positions of head, eye, and line of sight. A and B illustrate beginning and end of a continuous crown intercept measurement.*

to the operator is used as the reference point for measuring intercept. This point on the convex mirror produces a reflection resulting in a vertical projection of the overstory intercept to the transect tape. A small eyescrew, used to hold a plumbline, is attached to the box directly beneath this point.

When using the method, the operator straddles a tape marking a line transect, and holds the densiometer in front of his body at elbow height as shown in figure 1. At the start of a transect, the plumbline intersects the zero mark of the tape. With the densiometer leveled, the reflection of the technician's bare head should be just outside, but touching, the third line from the grid boundary closest to him. The sighting eye rather than the head should be centered on the line bisecting the third grid line.

In this position the operator moves along the tape until the reflection of crown foliage meets the reflection of his head. He reads the tape and records this beginning point of intercept. He then proceeds along the transect line to the point establishing the end of overhead foliage. This procedure is repeated on intermittent crown intercept until the transect end is reached. If the operator cannot straddle the tape, he may stand at the side and lean over the tape until his head, the densiometer, and the plumb bob are directly in line and above the transect tape.

## RESULTS

### Method Precision

A controlled laboratory test was made to check the precision of the densiometer as used in measuring line intercept above a transect. A line on an 8-foot-high ceiling--oriented at right angles to a transect tape--was used to simulate the beginning of crown intercept. An operator straddled a supported tape and took a series of 20 measurements on the same overhead line, reading to the nearest 0.01 foot. Before each measurement, the tape was moved a given distance, unknown to the operator, to eliminate possible bias. The maximum difference between repeat measurements was 0.08 foot and the standard deviation only 0.021 foot, indicating a high degree of precision.

## Variation Between Operators

Two operators independently estimated crown cover along six 50-foot transects in the mountain mahogany type and along eight 50-foot transects in the western juniper vegetation in central Oregon. Results indicate that the total length of crown intercept on any 50-foot transect would not vary more than 6 percent between operators in mountain mahogany, or 7.5 percent in western juniper, unless a 1-in-20 chance occurs in sampling. These differences will tend to decrease with increased total transect length.

The total length of crown intercept measured by operator A along six transect lines under mountain mahogany was 164.70 feet and 166.20 feet by operator B (table 1), a difference between operators of only 0.9 percent. Under juniper the total crown intercept was 191.60 feet by operator A and 192.90 feet by operator B, a difference between operators of only 0.7 percent.

An insignificant amount of variation in field measurements was inherent in the method itself; most of the difference was the result of the individual operator's interpretation of where solid crown cover begins and ends. This type of error is common to any procedure used in estimating crown intercept. It may be minimized by short training sessions for inexperienced operators.

## Measurement Time

The time required for measuring shrub crown by the direct line intercept, a commonly accepted field procedure, was used in this study as a yardstick for comparison with time required by the densiometer method.

Intercept measurements on 800 feet of transect were timed in the mountain mahogany type for the densiometer method, and 1,600 feet of transect was timed in low-shrub types, such as sagebrush-bitterbrush, for comparison. Densiometer readings were taken at an average rate of 4.42 feet of actual mountain mahogany crown intercept per minute and direct line intercept readings were taken at 4.44 feet of actual low-shrub crown per minute. These almost identical rates indicate that the densiometer method is suited for practical field use insofar as comparable time requirements are concerned.

Table 1.--Total crown intercept in feet per 50-foot transect for mountain mahogany and western juniper as measured by two operators

| Transect No. | Crown intercept | | | | | |
|---|---|---|---|---|---|---|
| | Mountain mahogany | | | Western juniper | | |
| | Operator A | Operator B | B-A | Operator A | Operator B | B-A |
| 1 | 35.90 | 35.50 | -0.40 | 31.90 | 31.50 | -0.40 |
| 2 | 21.50 | 22.50 | 1.00 | 17.50 | 16.20 | -1.30 |
| 3 | 24.70 | 25.50 | .80 | 12.80 | 13.90 | 1.10 |
| 4 | 28.60 | 28.60 | 0 | 27.40 | 27.60 | .20 |
| 5 | 35.10 | 35.80 | .70 | 29.70 | 30.70 | 1.00 |
| 6 | 18.90 | 18.30 | -.60 | 18.30 | 17.90 | -.40 |
| 7 | -- | -- | -- | 31.70 | 32.20 | .50 |
| 8 | -- | -- | -- | 22.30 | 22.90 | .60 |
| Total | 164.70 | 166.20 | 1.50 | 191.60 | 192.90 | 1.30 |
| Average | 27.45 | 27.70 | -- | 23.95 | 24.11 | -- |

## CONCLUSION

The method described for measuring crown intercept with the spherical densiometer appears to be an effective working tool for ecological studies involving tall shrubs and small trees. It provides precise and accurate estimates of crown cover, requires little instrumentation, and is simple and rapid in its operation. Results of tests reported here and subsequent field trials indicate that this method could be easily adapted to other vegetation types containing plant species of intermediate height.