

PACIFIC SOUTHWEST Forest and Range Experiment Station

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SEEN AREAS AND THE DISTRIBUTION OF FIRES ABOUT A LOOKOUT

Romain M. Mees

Standard procedures for the evaluation of fire lookouts have been time consuming and frequently highly subjective. A computer simulation model for evaluating existing lookouts has been described in another paper (Mees 1976). In addition to using the computation of gross and net discovery indexes as explained there, the manager can analyze existing and proposed lookout sites using an estimate of the distribution of past fires with respect to distance from the lookout.

This report describes two programs available for this purpose. The programs, SEEN and HIST, are written in FORTRAN for operation on the IBM 360¹. Copies of the programs are available upon request from the Director, Pacific Southwest Forest and Range Experiment Station, P. O. Box 245, Berkeley, California 94701, Attention: Statistical Services.

¹ Trade names and commercial enterprises or products are mentioned solely for necessary information. No endorsement by the U.S. Department of Agriculture is implied.

Mees, Romain M.

1978. Seen areas and the distribution of fires about a lookout. Gen. Tech. Rep. PSW-26, 7 p., illus. Pacific Southwest Forest and Range Exp. Stn., Forest Serv., U.S. Dep. Agric., Berkeley, Calif.

From the location of a fire lookout and the sites of past fires within a given radius about a lookout, an estimate of the fire distribution with respect to distance from the lookout can be obtained. The estimated distribution can include all fires located within a given number of feet below the last maximum line of sight from the lookout. Seen areas for the same lookout can be developed, stored, and plotted at a computer site for future work.

Retrieval Terms: fire lookouts; evaluation; line of sight; simulation models; computer programs; SEEN; HIST.

DISTRIBUTION OF FIRES ABOUT A LOOKOUT

In evaluating a lookout site, the distribution of historical fires about the site is examined with respect to distance from the lookout and distance below the last maximum line of sight from the lookout.

The procedure for determining the distribution is illustrated in *figure 1*. Here, fire 1 is directly visible; that is, it is in the seen area of the lookout because the angle measured between the horizontal and the fire 1 line of sight is less than the last applicable maximum line of sight—that is, angle α_1 . The second fire location is not visible because the angle measured from the horizontal exceeds the angle α_1 . Fire 3 is in a position similar to that of fire 2, whereas fire 4 is again directly visible and located in the seen area of the lookout.

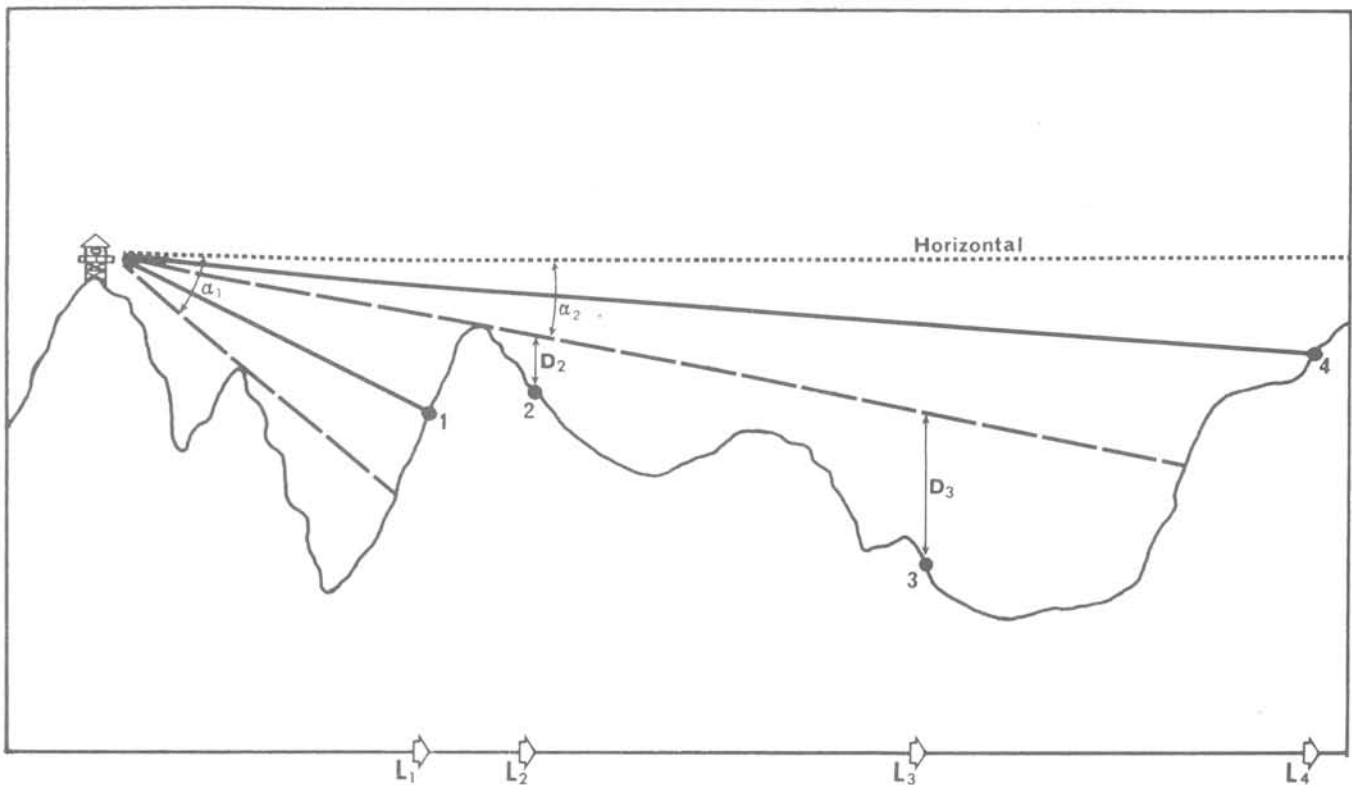


Figure 1—Fire locations 1 and 4 are in the seen area of the lookout. Fires 2 and 3 are below the last applicable maximum line of sight.

Although locations 2 and 3 are not directly visible, we can compute the vertical distances D_2 and D_3 shown in *figure 1*. The vertical distance D_1 is equivalent to the height of a smoke column needed for observation by the lookout. We also note that the fires are located at distances L_1 L_2 L_3 and L_4 from the lookout.

A computer program, HIST, has been developed to determine and plot all fires within a given distance either directly visible from the lookout or within some specified vertical distance D from the last maximum line of sight.

Historical fire data locations and topographic data for the San Bernardino National Forest are combined by program HIST, resulting in bar graphs (*figs. 2 and 3*).

As shown on the bar graph (*fig. 2*), 15 sites of past fires are in the seen area of the Project Peak lookout and within a distance of 4 to 5 miles (6.4-8 km); here the given vertical



Figures 2—The HIST program was used to produce this comparison between two existing lookouts (Strawberry and Keller Peaks) and one proposed site (Project Peak) for the years 1960 through 1969. Vertical column height represents the number of fires (indicated below the bar) located in 1-, 2-, and 3-mile circular increments about the lookouts for up to 15 miles ($D = 0.0$).

distance $D = 0$ feet. A similar graph for the Black Mountain lookout (fig. 3) with $D = 200$ feet shows 12 fires within 4 to 5 miles of the lookout and no more than 200 feet (61 m) hidden below the last maximum applicable line of sight.

The Project Peak lookout is a proposed site on the San Bernardino National Forest. The Strawberry and Keller Peak lookouts are operating lookouts for which the number of fires reported is known. Provided all local conditions are equal, the Project Peak lookout capability can be predicted by comparing the relative distributions.

Although the computed vertical distance D is highly dependent upon the accuracy of the lookout position and fire locations contained within the elevation data used, a good estimate of the distribution from the lookout and for a given vertical distance D can be obtained.

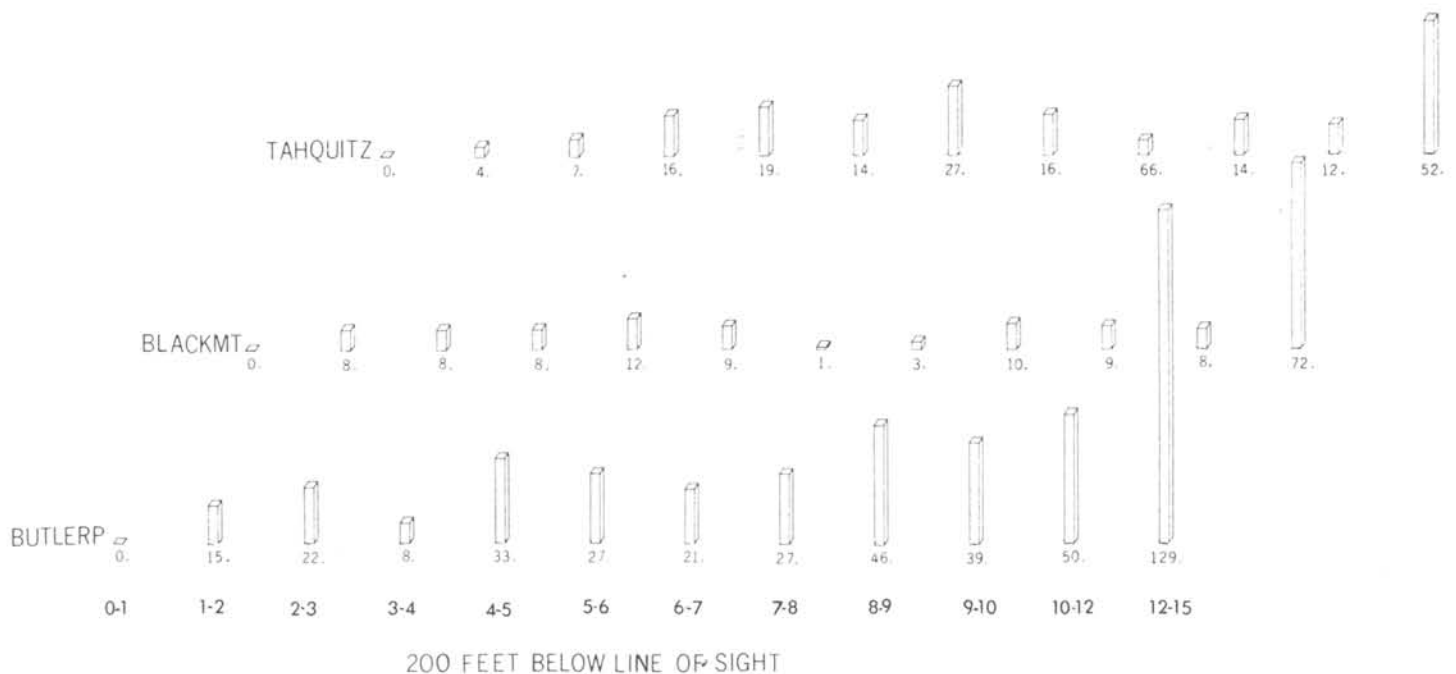


Figure 3—The HIST program was used to produce this summary of fire locations over the years 1960-69, for three lookouts (Butler Peak, Black Mountain and Tahquitz Peak) on the San Bernardino National Forest ($D = 200$ ft.).

SEEN AREAS

The same line-of-sight method and data can also be used to develop and plot seen areas for lookouts (Travis and others 1975). Again, the location and height of the lookout point must be combined with elevation data defined on a grid coordinate system as shown in *figure 4*.

Developing seen areas within a radius of 12 to 15 miles (19-24 km) of a lookout requires extensive elevation data and machine computation. To economize on both storage and computation, the SEEN program (Mees 1976) treats the area around the lookout one quadrant at a time, and takes advantage of the fact that all line of sight computations are identical, because of symmetry, with respect to the 45° line measured from the X-axis (*fig. 4*).

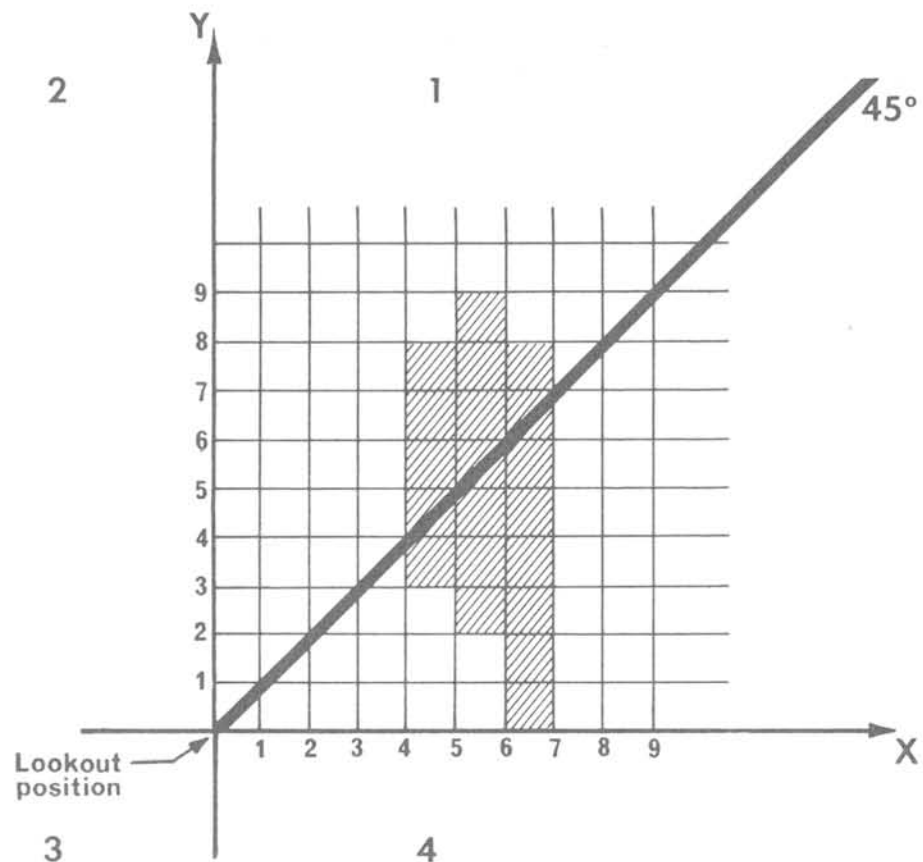


Figure 4—The area (shaded) seen from the detection point can be recorded by means of the values for the x and y axes and the number of visible squares. (Here the triplets are 4, 3, 5; 5, 2, 7; and 6, 0, 8.)

The seen areas produced by the SEEN program are plotted to any desired scale, usually 0.5 inch/mile, and are permanently stored at the computer site.

The SEEN program differs from existing seen area programs in that the program generates and retains a computer image of the seen areas for each lookout. The seen areas recorded can be used with a digital incremental plotter to produce a map overlay at any desired scale (*fig. 5*). The recorded seen areas can also be combined with fuel location data, wildland values, and other fire-related information for planning purposes. For example, the recorded seen areas have been combined with fire intensity areas to develop discovery indexes² for each lookout on the planning unit (Mees 1976).

²U.S. Forest Service. 1971. *National fire planning instructions*. final ed., 70 p., Washington, D.C.



Figure 5—Partial seen area for the Summit lookout—San Bernardino National Forest (scale 0.5 inch/mile).

LITERATURE CITED

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The Author

ROMAIN M. MEES is an operations research analyst with the FIREScope research work unit at the Forest Fire Laboratory, Riverside, California. He earned bachelor's and master's degrees in mathematics at the University of California, Riverside. He joined the Station's staff in 1971.



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