by
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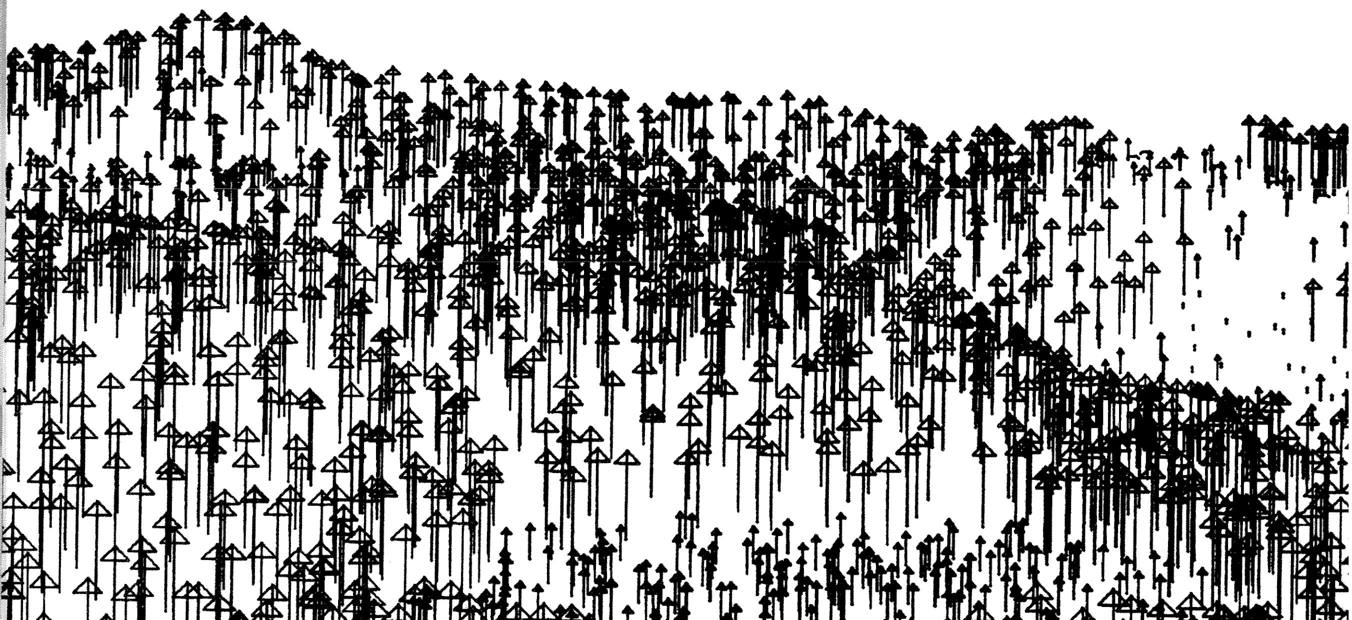
PREVIEW: Computer Assistance for Visual Management of Forested Landscapes



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THE AUTHORS

At the time this work was accomplished, Erik Myklestad and J. Alan Wagar were, respectively, research technician and project leader of the Environmental Interpretation Research Project formerly maintained by the USDA Forest Service in cooperation with the College of Forest Resources, University of Washington, Seattle. Wagar is currently leader of the Recreation Research Project maintained by the Forest Service in cooperation with the State University of New York College of Environmental Science and Forestry, Syracuse.

ABSTRACT

The PREVIEW computer program facilitates visual management of forested landscapes by generating perspective drawings that show proposed timber harvesting and regrowth throughout a rotation. Drawings show how changes would appear from selected viewing points and show landscapes as either a grid of distorted squares or by symbols representing trees, clearings, water, rock, etc. PREVIEW can also show roads and other linear features.

PREVIEW requires digitized data for uniformly spaced points in a grid of up to 100 columns and 80 rows. For distorted square drawings, only elevations are needed. For drawings with symbols, data must also include vegetation or surface type codes and, when appropriate, tree heights. At a spacing of 100 feet between adjacent points, the maximum (100 x 80) grid covers approximately 2.9 square miles.

In addition to the cost of preparing data, computer and plotter costs are incurred. These depend on the computer and plotter used, the size of the grid, the number of points visible from the viewing point, and the density of symbols used. Computer (CDC 6400) and plotter (Calcomp 936) costs were approximately $16 for a drawing that plotted vegetation and ground cover symbols for approximately 2,800 visible points from a data grid of 7,200 points embracing 1,653 acres.

PREVIEW is controlled by a series of instruction cards that specify data entries, viewing point(s), angle(s) of view, drawing center point(s), scale of drawing(s), rates of tree growth, normal and shelterwood tree densities, representation as distorted-square or vegetation and surface-type symbols, and year(s) after beginning of rotation.

KEYWORDS: Visual management, Timber management, Land-use planning, Landscape management, Scenery, Computer graphics.

PREVIEW: Computer Assistance for Visual Management of Forested Landscapes

Introduction

BY SHOWING the visual effects of proposed timber harvesting, regrowth, and other landscape changes, computer-generated drawings of groundform and vegetation can greatly assist in the visual management of forested landscapes *(Kojima and Wagar 1972)*. To realize this potential, the PREVIEW computer program was created. In PREVIEW, the earlier groundform and vegetation programs developed by Kojima were combined and rewritten to reduce costs and increase capacity and flexibility. This paper discusses the characteristics, use, costs, and availability of the PREVIEW program.

What PREVIEW Does

PREVIEW lets managers of visual resources convert mapped proposals into perspective drawings that show how proposed landscape changes would appear from selected viewing points. It can represent landscapes by a grid of distorted squares, by vegetation and other ground-cover symbols, or both (compare figs. 1, 2, and 3). It can also plot perspective views of road systems, power lines, boundaries, and other linear features (fig. 3).

In addition to showing landscapes at a single moment, PREVIEW has been designed to handle a series of timber harvesting entries and the regrowth occuring between them. This permits analysis of the visual effects to be expected from alternative timber harvesting schemes throughout an entire rotation (figs. 4 and 5). If this is not done, shaped settings that give good visual results for the first entry may leave awkward visual problems for the second or third entries.

The drawings created by PREVIEW are design aids that must be interpreted in conjunction with maps, photographs, field observations, or other sources of information. Users should understand, for example, that because of the relatively sparse distribution of tree symbols on vegetation drawings, proposed changes may appear less harsh on such drawings than on the ground (fig. 6). In some cases, sketching of additional detail, such as the solid wall of stems surrounding a clearcut, may clarify the visual effects of a proposed change.

TEXT CONTINUES ON PAGE 7.

Figure 1.—Looking west toward Boulder Creek and Boulder sale area from a point 7 miles west-northwest of the summit of Mount Adams, Mount Adams Ranger District, Gifford Pinchot National Forest, Oregon.

Figure 2.—Distorted-square representation of view toward Boulder Creek, Gifford Pinchot National Forest, as drawn by PREVIEW with 100-foot spacing between elevation data points. Original drawing is 27 inches long.

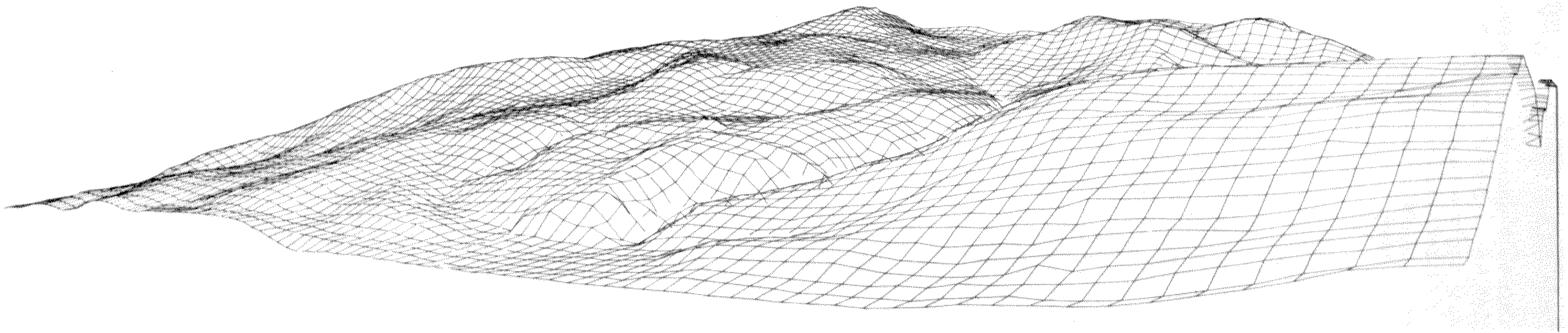


Figure 3.—Vegetation and surface-type representation of view toward Boulder Creek, Gifford Pinchot National Forest, as drawn by PREVIEW. Scale is 100 feet between data points. Road system was drawn by PREVIEW as a separate overlay but has been superimposed here. The symbols that are convex upward represent lava flows.

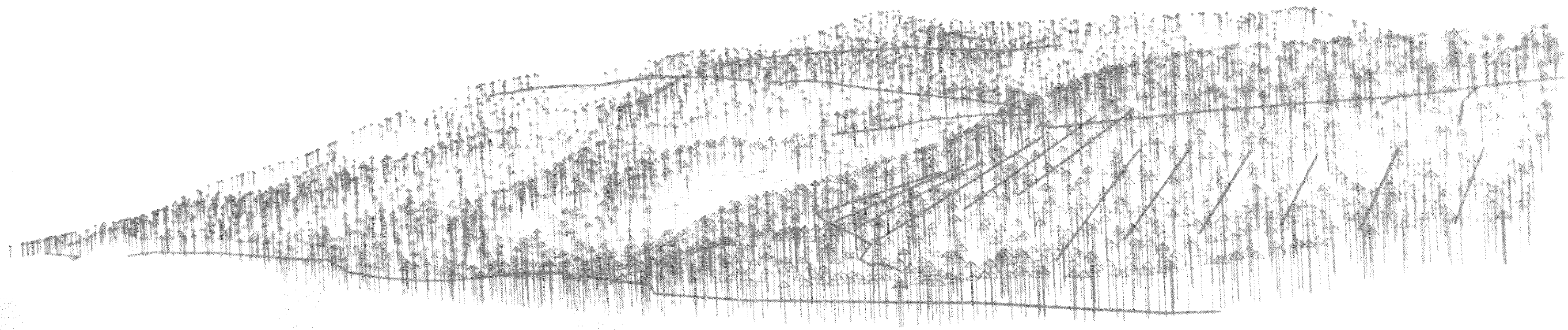


Figure 4.—Preliminary sale layout designed for minimal visual degradation by landscape architect Ronald Tuttle and personnel of the Mount Adams District, Gifford Pinchot National Forest. *Block A:* Eight shelterwood entries and two clearcut entries, all at 20-year intervals. Visual objective is to maintain a timbered texture while increasing textural diversity during a 160-year conversion period. *Block B:* Five clearcut entries at 38-year intervals. Visual objective is to use small clearcuts to repeat the natural openings created by lava-flows.

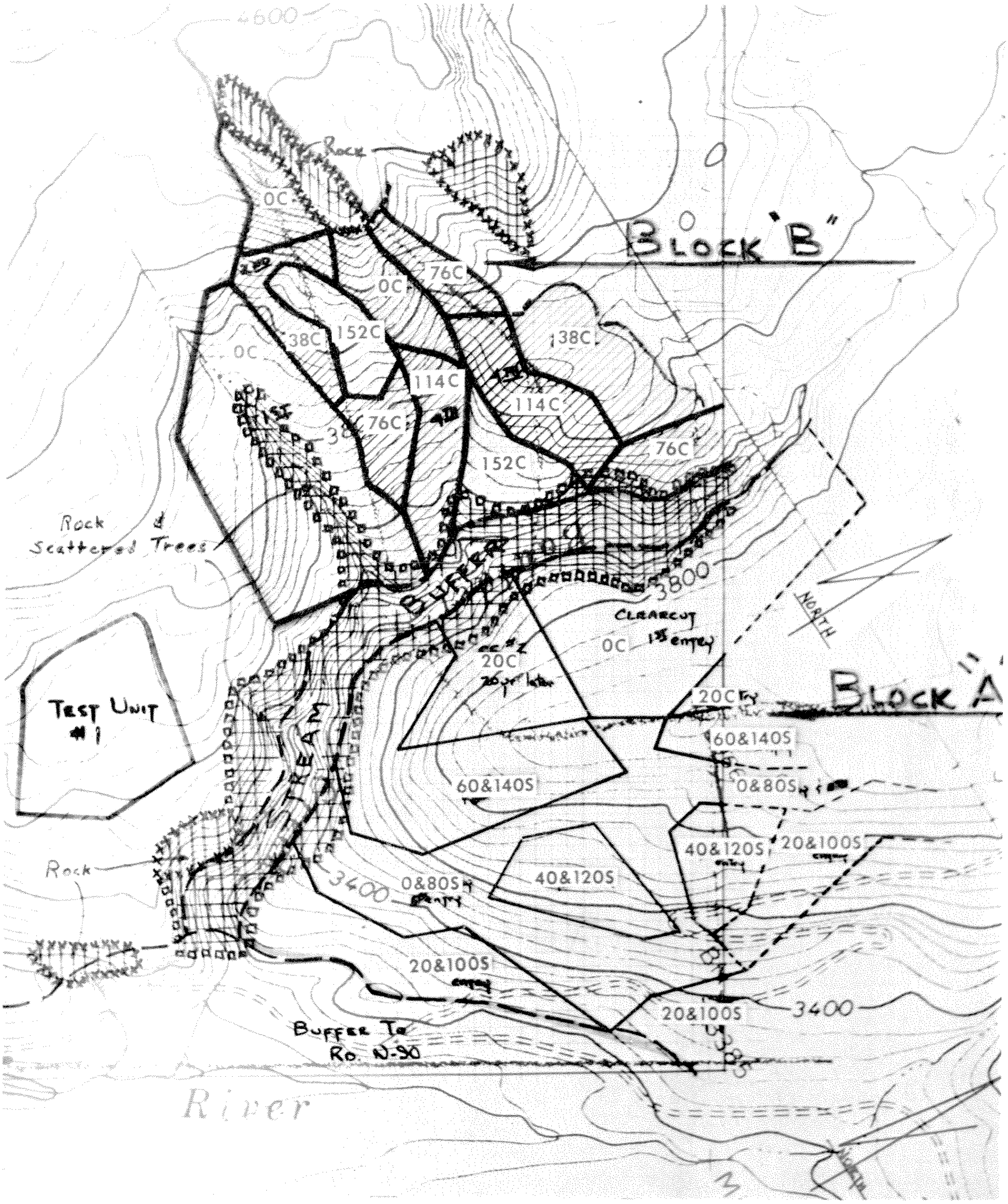
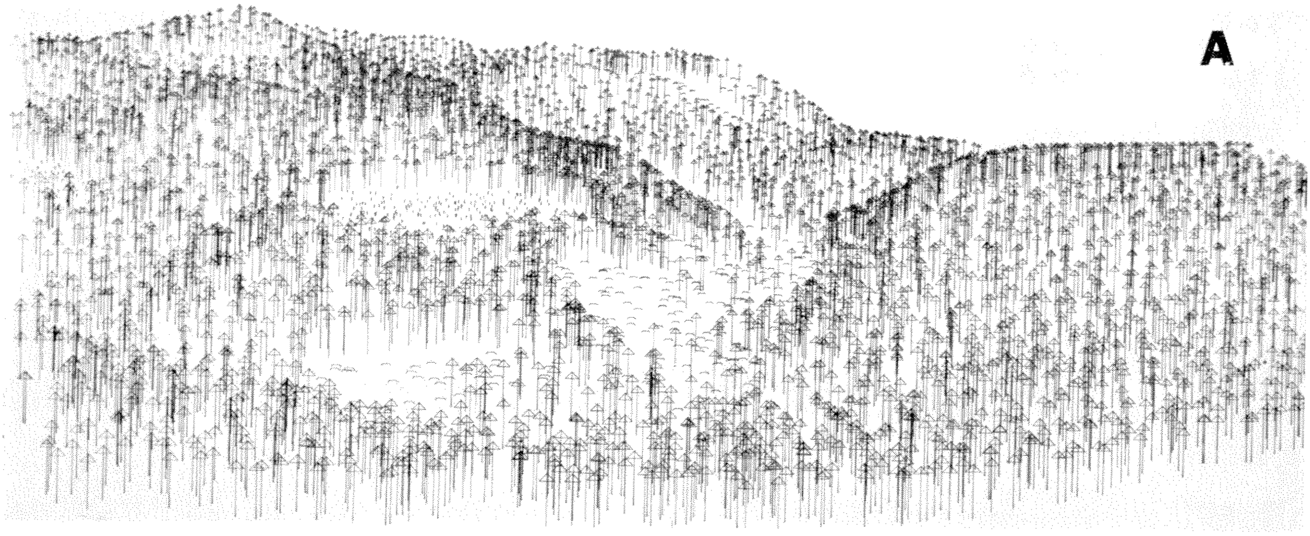
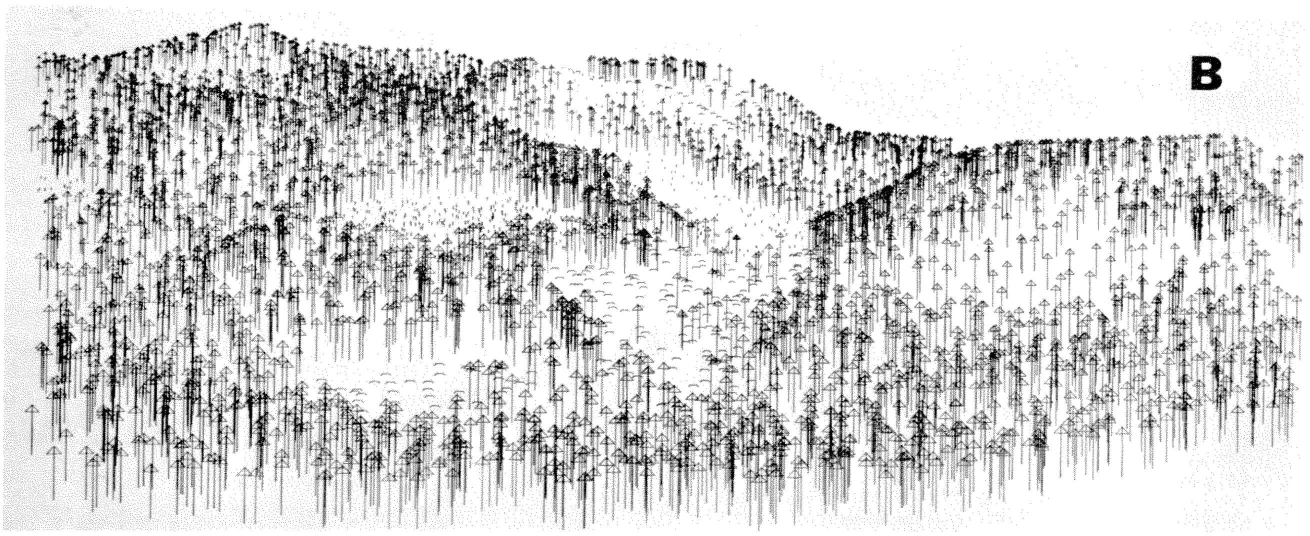


Figure 5.—Computer-generated preview of 152 years of timber harvesting designed for minimal visual degradation, Boulder sale area, Mount Adams District, Gifford Pinchot National Forest. *A*. Year 1 (showing test unit 1 but no other cutting). *B*. Year 1 (1 year after initial clearcut and shelterwood entries). *C*. Year 39 (1 year after second clearcut in Block B and 19 years after second shelterwood entry). *D*. Year 115 (1 year after fourth clearcut in Block B and 15 years after sixth shelterwood entry). *E*. Year 153 (1 year after fifth clearcut in Block B and 13 years after eighth shelterwood entry). Scale is 100 feet between data points.





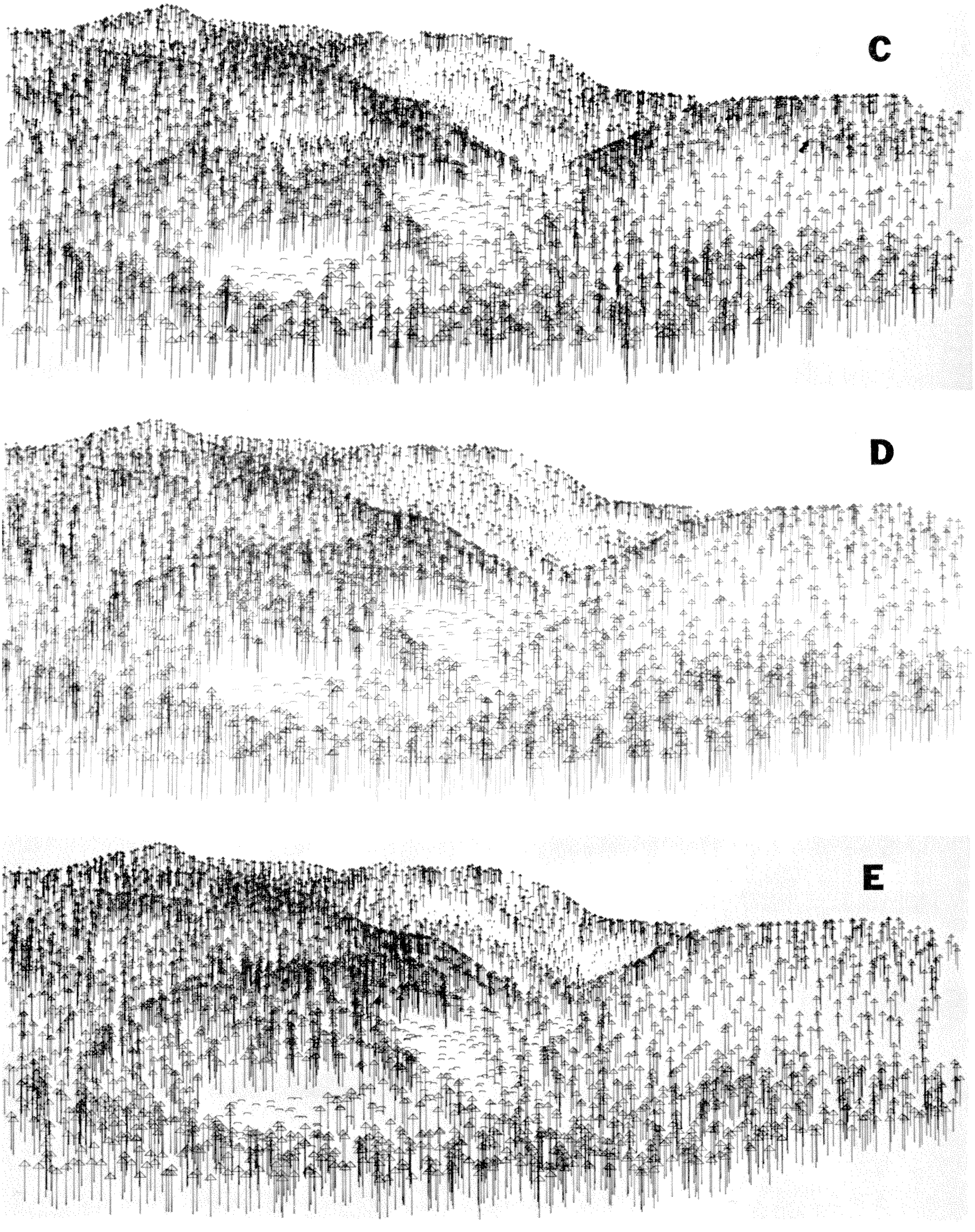

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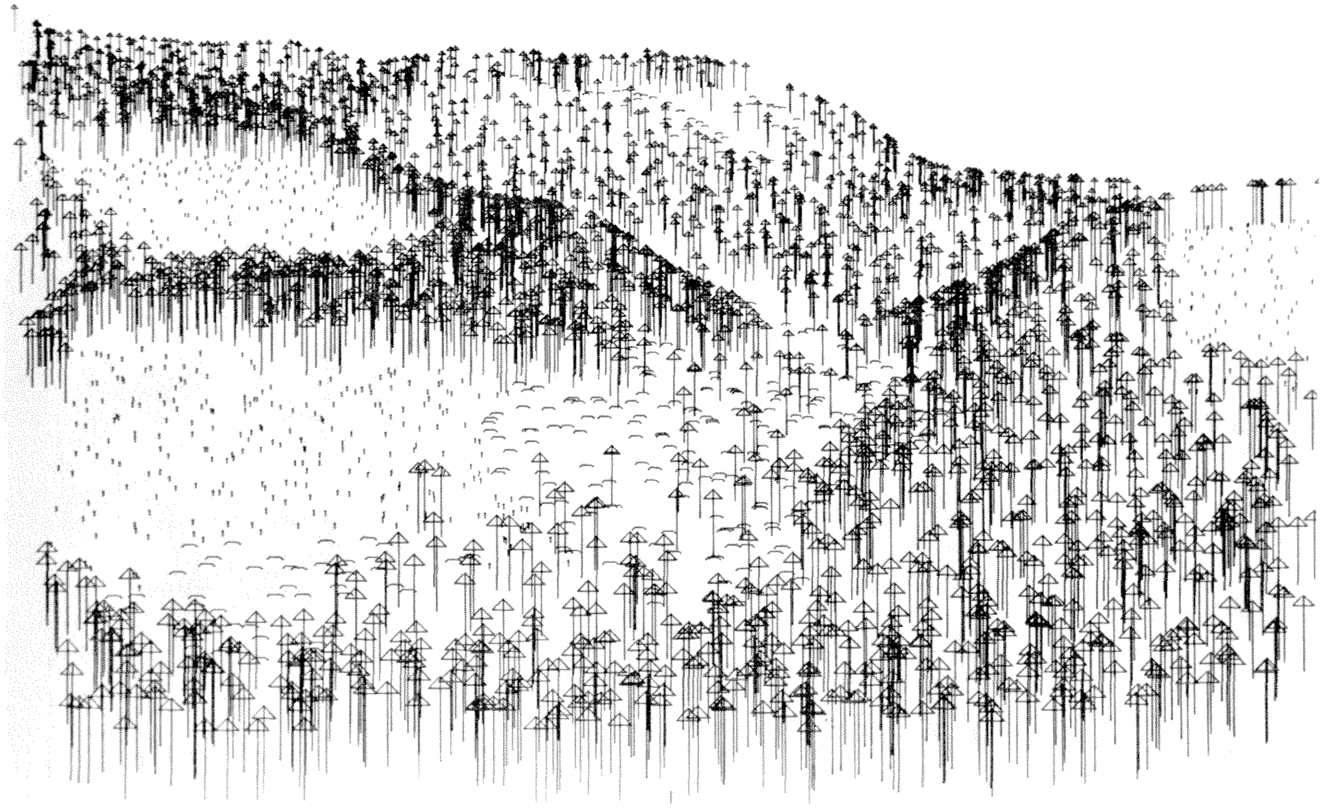
Figure 6.—Hypothetical clearcuts in rectangular blocks. Because PREVIEW represents vegetation by randomly spaced symbols around relatively few grid points, boundaries of clearings may appear less harsh on drawings than on the ground.



Characteristics of PREVIEW

PREVIEW is written in FORTRAN and is currently adapted to a CDC 6400 computer with an off-line Calcomp 936 drum plotter.[1] However, it should be easily adapted to other systems with equivalent capacity.

The program requires digitized data for a grid of up to 8,000 uniformly spaced points (100 columns by 80 rows). For distorted-square drawings, only elevations are needed. For vegetation drawings, data must also include ground-cover types and, in some cases, heights. Currently, a vegetation drawing can include any combination of nine ground surface or cover types (fig. 7). They are:

Code no.	*Surface type or cover*
01	Conifers
02	Hardwoods
03	Fallen timber
04	Water
05	Grass or brush
06	Rock
07	Rock with scattered conifers
08	Rock with scattered hardwoods
09	Coniferous shelterwood

Additional symbols can be developed if needed. Scale is controlled by defining the distance between grid points.

The center point for each drawing must be one of the grid points. However, the viewer's position can be specified anywhere within or outside the grid (fig. 8). Views of any width between 1 and 90 degrees can be plotted.

Drawings are normally plotted as if pro-

[1] PREVIEW has been adapted recently to an IBM 370 computer. Commercial names are used only for identification; their use implies no endorsement by the Department of Agriculture or the Forest Service.

Figure 7.—Ground surface or cover symbols currently used by PREVIEW program. From left to right and top to bottom, symbols are conifers, hardwoods, and felled stems; water surface, grass or brush, and rock outcrop; and rock with scattered conifers, rock with scattered hardwoods, and coniferous shelterwood.

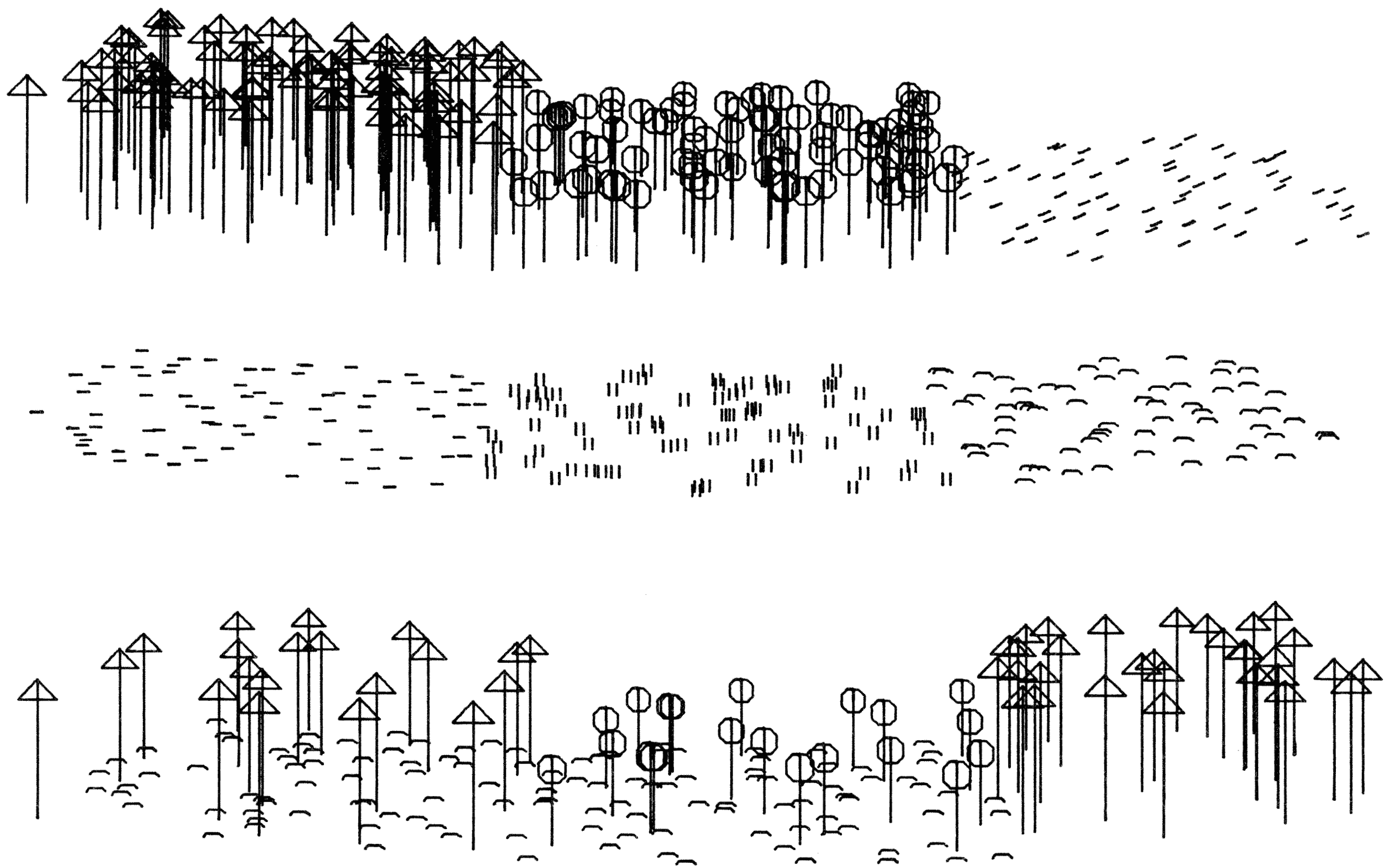
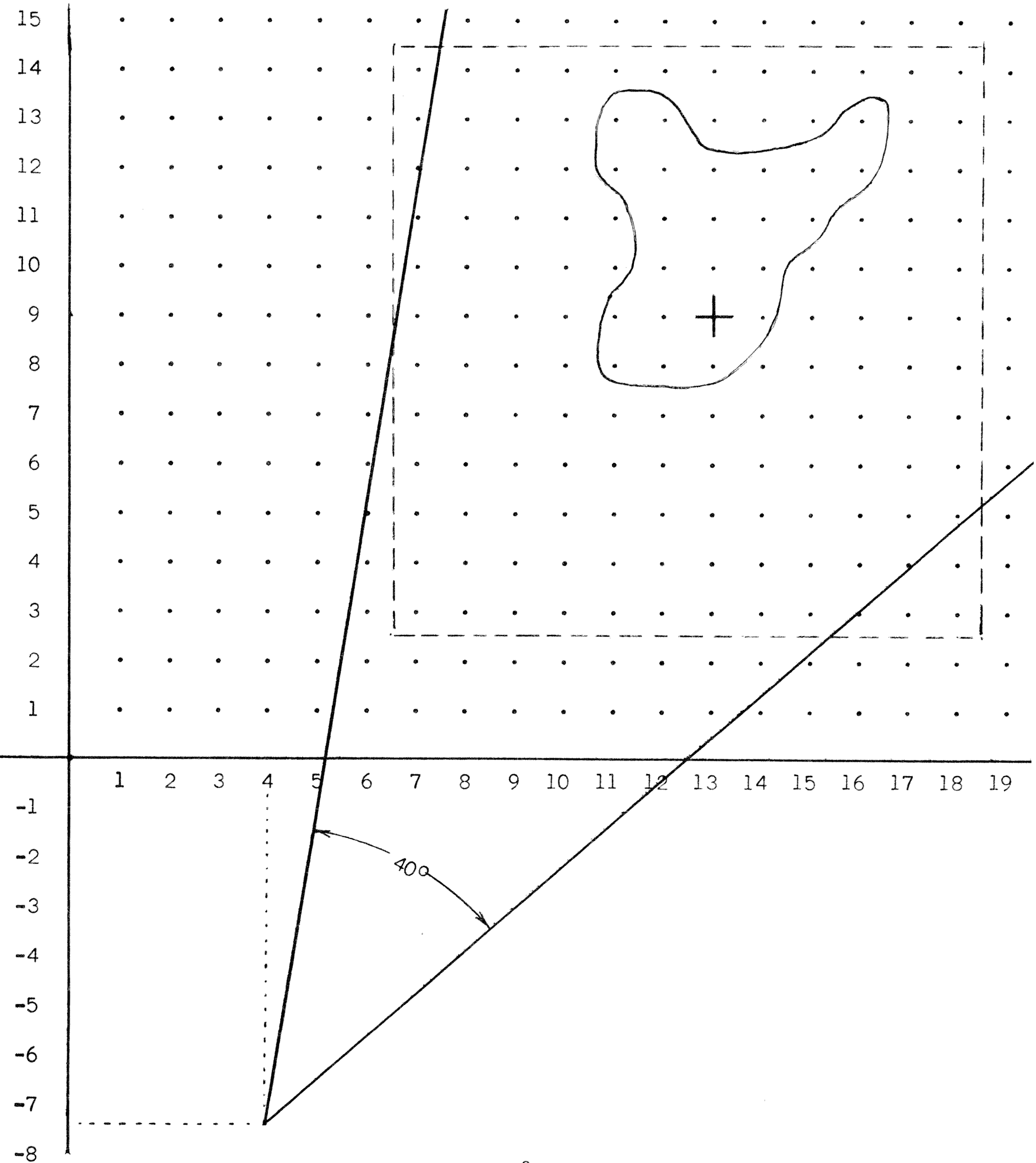


Figure 8.—Grid showing 40-degree angle of view from standpoint (4,-7.5) toward centerpoint (13,9). Data can be entered or plotted for any rectangular portion of the grid—such as the area bounded by dashed lines. Data for freeform areas can be entered by row segments. For the freeform area shown, data would be entered for row 13, x=11-12; row 13, x=16-16; row 12, x=11-16; . . . row 8, x=11-13.



jected on a flat surface 18 inches from the eye of the viewer. However, options are provided to enlarge or reduce either the size of an entire drawing or its vertical dimension.

Symbols on the vegetation drawings are placed around each grid point that, in the absence of vegetation, would be visible from the viewing point. Tree symbols are drawn to correct perspective scale. This is determined by the tree height first defined for each grid point, subsequent height growth, and the distance between the grid point and the viewing point. The density of symbols (i.e., the maximum number for any grid point) is controlled by the user of PREVIEW. Also, the number of symbols around each point decreases with distance from the viewing point, substantially reducing plotting time.

To permit modification and examination of small areas, flexibility has been built into both data entry and plotting (fig. 8). Data can be entered or plotted for any rectangular portion of the 100- by 80-point grid. This avoids handling the entire grid when examining alternatives that involve only part of it. To create irregular shapes, data can also be entered by rows or segments of rows.

Users control the PREVIEW program with a series of instruction cards. These specify:

1. Grid dimensions (number of columns and rows), grid scale (distance between grid points), maximum tree height, and age at which this height is reached. This height and age permit approximate height growth to be plotted for any period specified.

2. Pattern of data entry (i.e., rectangular blocks or segments of individual rows), "common" tree heights and elevations (used to avoid an entry for every grid point for such situations as even-aged stands and large water surfaces), and years after time zero. (The initial data entry is specified as time zero; subsequent data entries are identified by the number of years after it.) Data for uniform ground cover are usually entered in rectangular blocks. Adjustments to these data are normally for the individual row segments that make up the appropriate freeform areas (fig. 8).

3. Viewer position, center point for the perspective drawing(s), and angular width of view.

4. Grid area to be plotted, plotting of distorted squares or vegetation or both, time of plot (years after time zero), and (if appropriate) density of symbols and density of shelterwood. An option is also provided to reuse previous computions when plotting a series of vegetation drawings; this saves substantial amounts of computer time.

5. End of desired computer run. Before this instruction is used, other instructions may be repeated to provide a variety of drawings from as many viewing points as specified.

In addition to the instructions listed above, the following options are provided:

6. List data for grid points in any rectangular area specified.

7. Alter size of drawings.

8. Alter vertical dimension only.

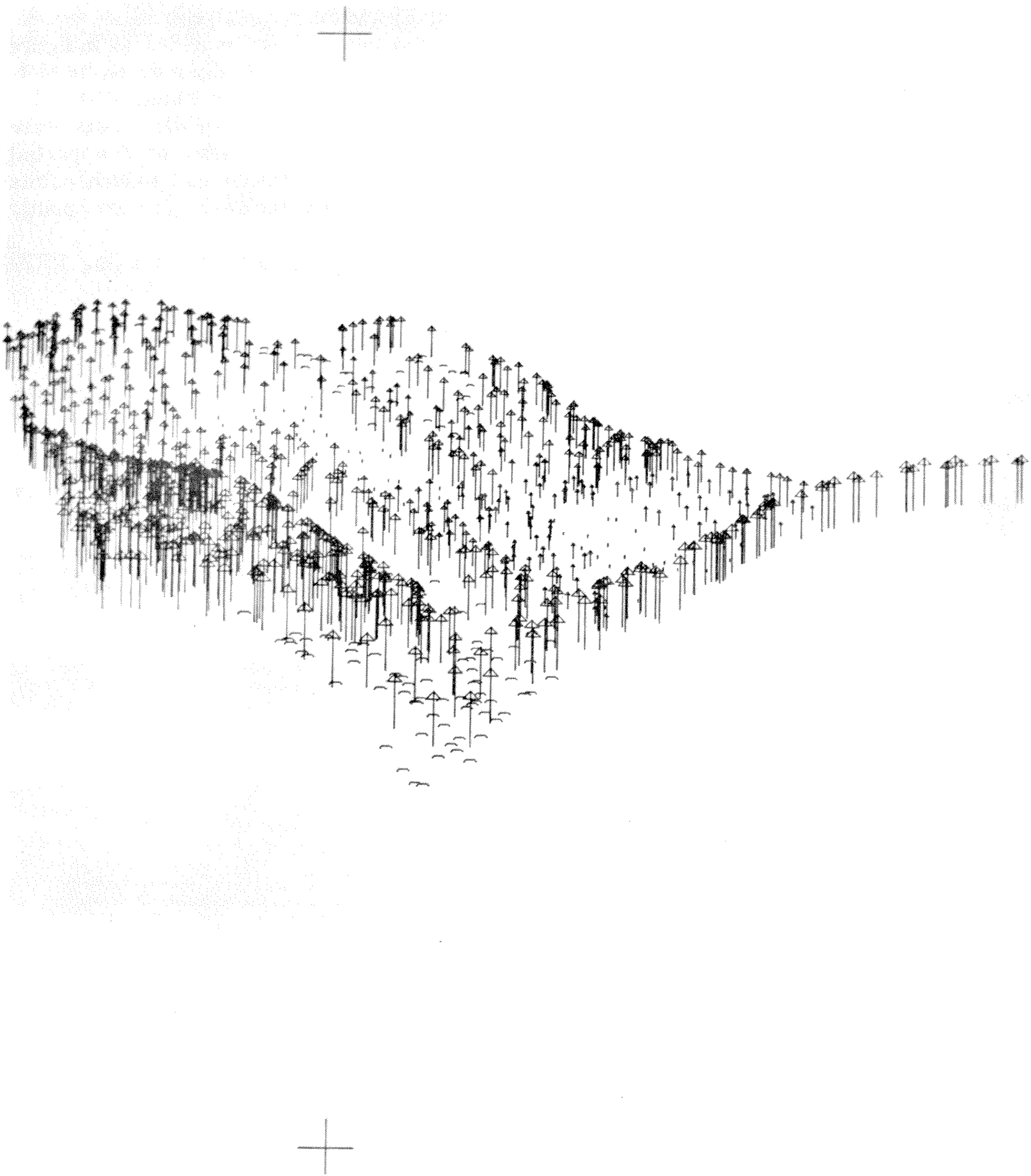
9. Read and plot data for roads or other linear features (up to a maximum of 300 points).

Data Requirements, Costs, and Availability

Digitizing elevation data can be a substantial cost in the application of PREVIEW, and improved procedures may be needed. From a topographic map enlarged to a scale of 400 feet to the inch, elevations were interpolated at 290 points per hour—approximately 25 man-hours for a 7,200-point grid. Keypunching of elevation and ground-cover data for the same grid took approximately 6 hours.

Other "data acquisition" options need to be explored. Digitized elevation data for the entire country are available from the Defense Mapping Agency at a scale of approximately 208 feet between grid points (one point per acre). This is approximately one-fourth the grid density illustrated here, but may be adequate for many situations. Equipment is

Figure 9.—Partial view for year 153 showing only the area affected by proposed clearcuts. Crosses at top and bottom of each view facilitate correct register of overlays on a larger drawing. Scale is 100 feet between data points.



available to digitize elevation data directly from stereo photo pairs, but we did not explore this. Nor did we explore commercial programs for digitizing elevation data. One available program permits tracing of contour lines on digitizer equipment and provides one elevation point per acre *(Travis, Elsner, and Kourtz 1973)*.

If not already available, an efficient program might be developed to interpolate elevation points within rather uniform surfaces bounded, in many cases, by widely separated contour lines. This would avoid the need to trace every contour on digitizing equipment.

Once digitized data are available, the user of PREVIEW incurs computer costs and plotter costs, both of which vary. Computer costs depend on the computer used, the size of the grid, the width of view, and the number of points visible. Because five times as many symbols are plotted for points next to the viewer as for distant points, plotter costs depend greatly on the number of visible points close to the viewer. For the computer-plotter combination mentioned, costs for figures 2 and 3 were approximately $12 and $16, respectively. Each of these figures includes approximately 2,800 visible points (640 visible acres) from a data grid of 7,200 points embracing 1,653 acres. The cost for figure 2 includes $5 for computer time (at $0.03333 per "resource unit") and $7 for plotter time (at $24 per hour). Computer and plotter costs for figure 3 were approximately $7 and $9, respectively.

When a view is being modified, as in figure 5, costs can be substantially reduced by plotting only the portion that changes (fig. 9). Combined computer and plotter costs were $4.32 per view for a series of five partial views. With both visible and hidden points counted, each view included 1,333 grid points (306 acres).

Listings and instructions for using PREVIEW are available from:

Recreation Research Project
Forest Service, USDA
c/o State University of New York
College of Environmental Science & Forestry
Syracuse, New York 13201

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Acknowledgments

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