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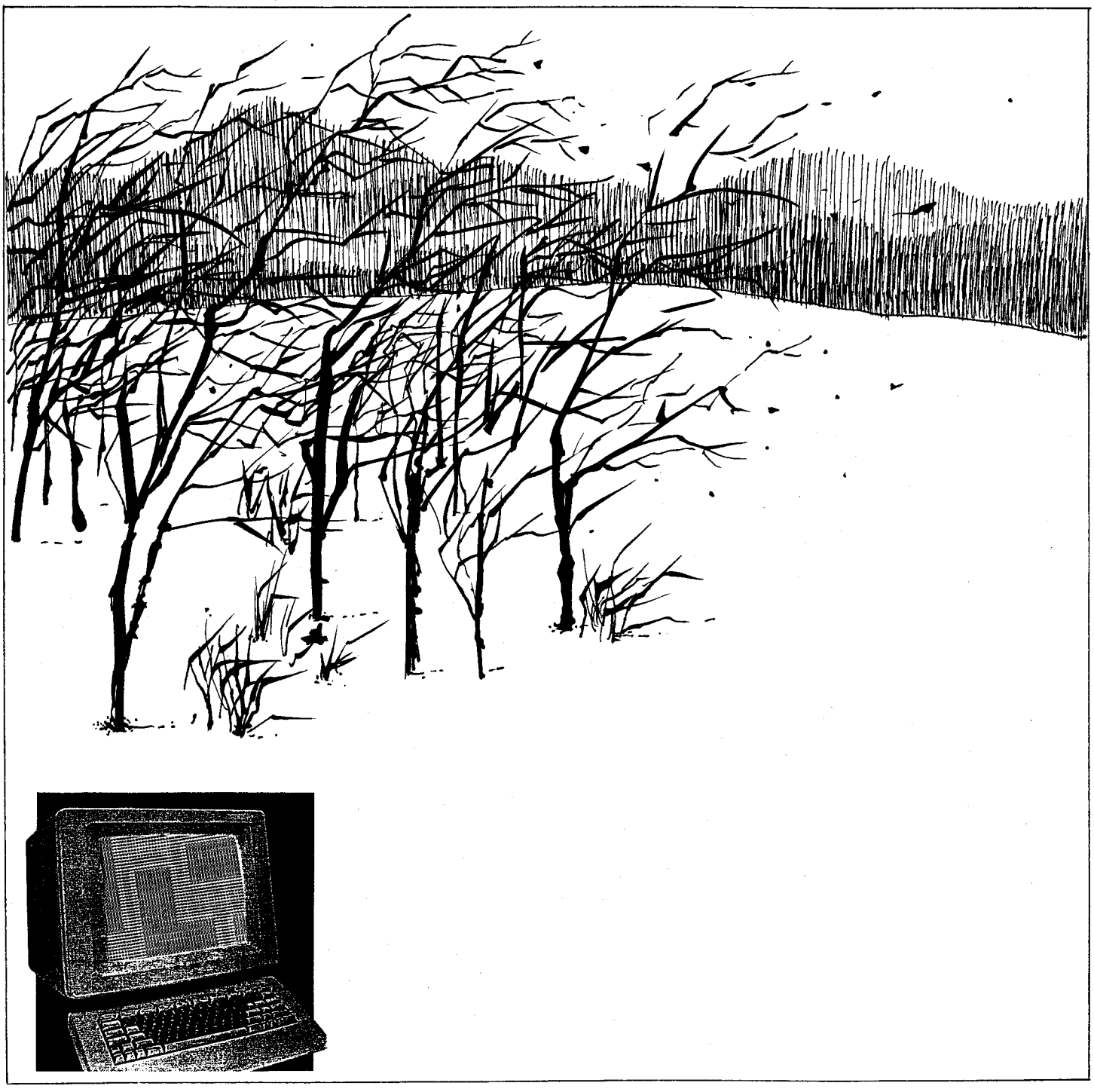
Microcomputer Software for Calculating an Elk Habitat Effectiveness Index on Blue Mountain Winter Range

Mark Hitchcock and Alan Ager



Erratum

Publication: *Microcomputer Software for Calculating the Elk Habitat Effectiveness Index on Blue Mountain Winter Range*, PNW-GTR-301, July 1992

Authors: Mark Hitchcock and Alan Ager

Software: The HEICALC software can be obtained by emailing Alan Ager at aager@fs.fed.us.

Authors

MARK HITCHCOCK is a consulting forester, 2347 Old Day Creek Road, Sedro Woolley, WA 98284; and ALAN AGER is an operations research analyst, U.S. Department of Agriculture, Forest Service, Umatilla National Forest, 2517 Hailey Avenue, Pendleton, OR 97801.

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Abstract

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National Forests in the Pacific Northwest Region have incorporated elk habitat standards into Forest plans to ensure that elk habitat objectives are met on multiple use land allocations. Many Forests have employed versions of the habitat effectiveness index (HEI) as a standard method to evaluate habitat. Field application of the HEI model unfortunately is a formidable problem, owing largely to the detailed calculations of "spacing bands" that describe the spatial arrangement of forage and cover areas. This paper describes a DOS microcomputer program that automates the calculation of HEI. "HEICALC" is a simple, menu-driven program that will run on virtually any DOS microcomputer. HEICALC vastly simplifies the task of measuring elk habitat conditions over large areas. It is especially useful in projects where several management alternatives are evaluated for their effects on elk habitat. A floppy diskette containing a copy of the program is distributed with the publication.

Keywords: Elk habitat, HEI, wildlife software, Blue Mountains.

Contents

Introduction

The habitat effectiveness index (HEI) is a quantitative measure of habitat quality for elk. It was developed to provide wildlife biologists with a tool to objectively quantify use of habitat by elk. Several variants of HEI have been developed to account for differences in habitat use by geographic area and for summer versus winter range in Oregon (Black and others 1976; Thomas and others 1979, 1988; Wisdom and others 1986). While research to validate these models continues, HEI has found wide application for measuring and monitoring elk habitat Nearly all National Forests in the Pacific Northwest Region have incorporated HEI standards into Forest plans as part of their land use allocations. Field assessment of HEI is a formidable problem, owing largely to the detailed calculations of "spacing bands" that describe the spatial arrangement of forage and cover areas. We therefore began work to automate HE[calculations and started with the Blue Mountain winter range model (Thomas and others 1988). This report describes the result: a DOS microcomputer program called "HEICALC."[1] We provide a general description of the program and detailed instructions for its use.

The Elk Winter Range Model

The HEICALC program calculates HEI from coefficients of habitat use for winter ranges published by Thomas and others (1988). This model evaluates four habitat components: the size and spacing of cover and forage areas, the density of roads traveled by motorized vehicles, the quantity and quality of forage, and the quality of cover. Each is measured with subindexes ranging from 0.0 (no value) to 1.0 (optimum condition). The HEI is computed as the geometric mean of these subindexes as follows:

$$HEIsrfc = (HEs \times HEr \times HEf \times HEc)^{1/N},$$

where:

HEs = habitat-effectiveness index derived from size and spacing of cover and forage areas;

HEr = habitat-effectiveness index derived from the density of roads open to vehicular traffic;

HEf = habitat-effectiveness index derived from the quantity and quality of forage;

HEc = habitat-effectiveness index derived from cover quality; and

1/N = Nth root of the product taken to obtain the geometric mean, which reflects the compensatory interaction of the N factors in the HE model.

Getting Started

Hardware Requirements

HEICALC is written and compiled in TURBO Pascal, 2 version 6.0, and operates on IBM-compatible microcomputers with DOS version 2.0 or later. HEICALC automatically detects the type of video display installed (for example, monochrome, VGA, EGA, CGA) and takes advantage of the capabilities of each. A 1.2-megabyte (MB) floppy drive is required to read the distribution diskette. HEICALC prints on most printers by using the standard ASCII printer control characters to control formatting. Random access memory (RAM) requirements depend on project area size; at least 130 kilobytes (KB) must be available to load the program and process habitat maps

[1] The use of trade or firm names in this publication is for reader information and does not imply endorsement by the U.S. Department of Agriculture of any product or service.

[2] TURBO Pascal is a registered trademark of Borland International, Scotts Valley, CA.

Table 1—Habitat code definitions

Code	Habitat type
1	Forage area
2	Marginal cover
3	Satisfactory cover
4	Harvest treatment area

having 60,000 pixels (31,000 acres for maps with 50- by 50-yard pixels). Larger maps require more memory. The maximum map size accommodated by the program, 600 columns by 800 rows (ca. 240,000 acres at 50- by 50-yard pixel size) requires 540K RAM. A math coprocessor and a mouse with a Microsoft-compatible driver are optional equipment.

Installation

The distribution diskette contains five files. HEICALC.EXE is the executable program for calculating HEI. SAMPLE.MAP and SAMPLE.DB are a sample habitat map and a database, respectively. HEIUTIL.EXE is a utility program facilitating the conversion of MOSS-MAPS geographic information system (GIS) data to the HEICALC format. B.COM is a file-browsing utility that can be used in conjunction with HEIUTIL.EXE. No special installation routines are necessary to run HEICALC or the accessory programs. They can be run directly from the distribution diskette or copied onto a hard drive. It is convenient to create a subdirectory (for example, C:\HEI) on the hard drive into which the files can be copied and the program executed.

Program Overview

HEICALC.EXE calculates HEI components from a digital habitat-type map and from numerical data on forage and open road mileage. Open road mileage and forage quality and quantity data are entered from the keyboard with each HEICALC session by using menu options. Cover data are derived from a habitat map constructed for each project area. The habitat map is an ASCII computer file in which an original line map has been translated into a grid of square pixels of a fixed area. The pixel size can be set by the user, the maximum size being 100 yards on a side (2.066 acres). The cover type of each pixel (for example, satisfactory cover, marginal cover, forage) is represented by one of four codes as shown in table 1. As an example, figure 1A shows the map published by Thomas and others (1988, p. 14), and figure 1 B shows the same map in HEICALC format.

Methods Used by HEICALC for Calculating HEI

The calculation of the individual HE components by the HEICALC is described briefly below. Refer to Thomas and others (1988) for details.

The HEs to measure the size and spacing of forage and cover areas is calculated by HEICALC with a search algorithm that moves to each pixel on the map and determines the linear distance to the nearest pixel of opposite habitat type (forage versus cover). The distance is used to classify the pixel and associated acreage for the distance bands. The HEs is then calculated by using the weighting factors as described in Thomas and others (1988). The classification of pixels into distance bands is illustrated in figure 2 for the example map in figure 1.

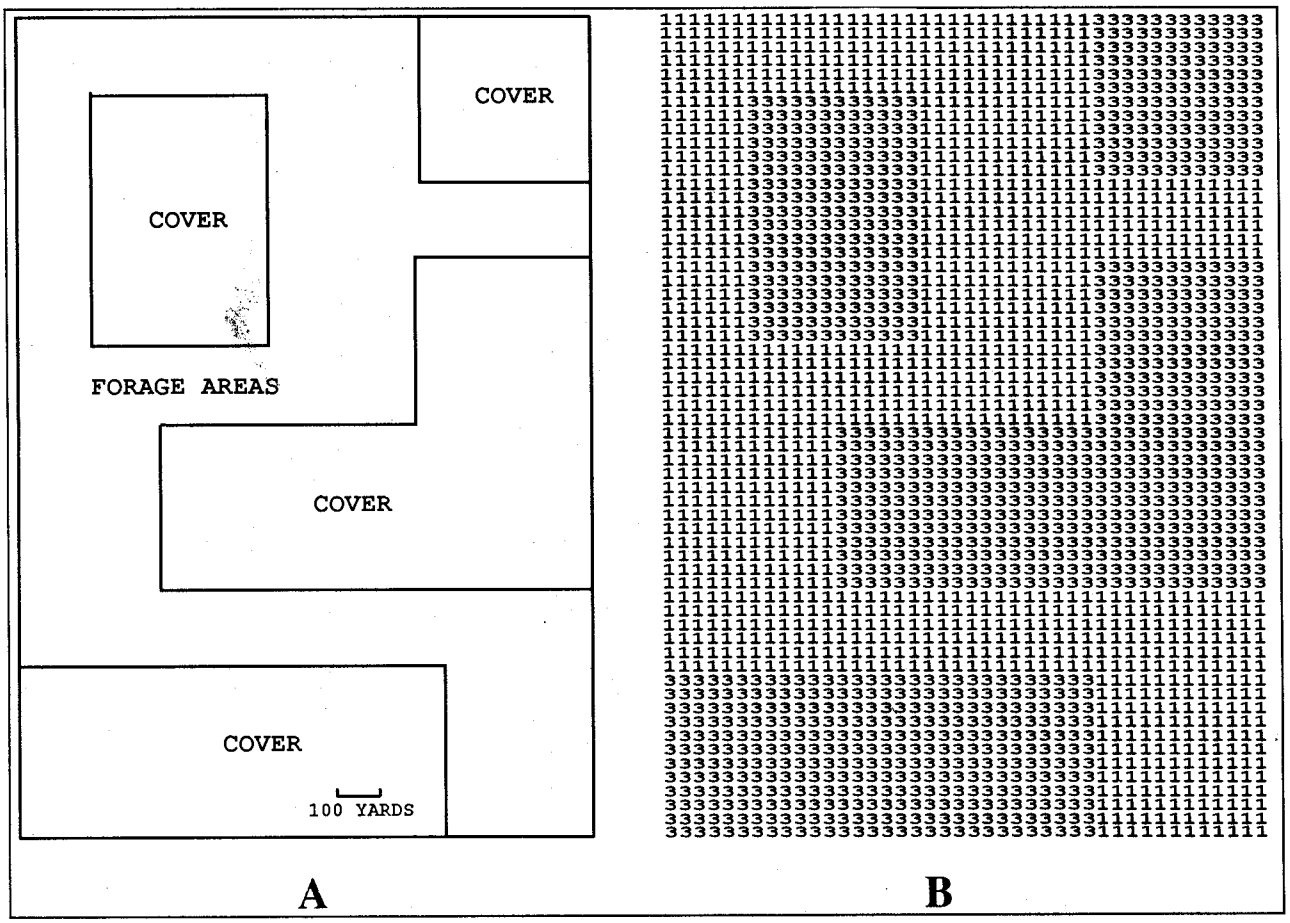

Figure 1—**(A)** Reproduction of the example habitat map from Thomas and others (1988, p. 14). **(B)** Map in (A) as represented in raster format used by HEICALC. Each symbol represents a 50- by 50-yard pixel (0.517 acre) of a specific habitat type: 1 = forage and 3 = satisfactory cover

The HEr to measure the effect of open road density is calculated according to equations developed by Lyon (1983), as depicted in figure 2 of Thomas and others (1988). The appropriate equation depends on the road density. If the road density (RD) is less than 1.1 miles/per square mile then,

$$HEr = 0.4 + [(6 - RD)/6]^6 \times 0.6$$

If the road density is greater than or equal to 1.1 miles/per square mile but less than 2 miles/per square mile then,

$$HEr = 0.486 + 0.092 \times (2\text{-}RD)/0.89$$

If the road density is greater than or equal to 2 mile/per square mile but less or equal to 6 miles/per square mile then,

$$HEr = 0.104 + (6\text{-}RD)/4 \times 0.382$$

If the road density is greater than 6 miles/per square mile then HEr = 0.104.

Hence, an analysis area with no open roads has an HEr value of 1.0. An open road density greater than 6.0 has an HEr value of 0.104.

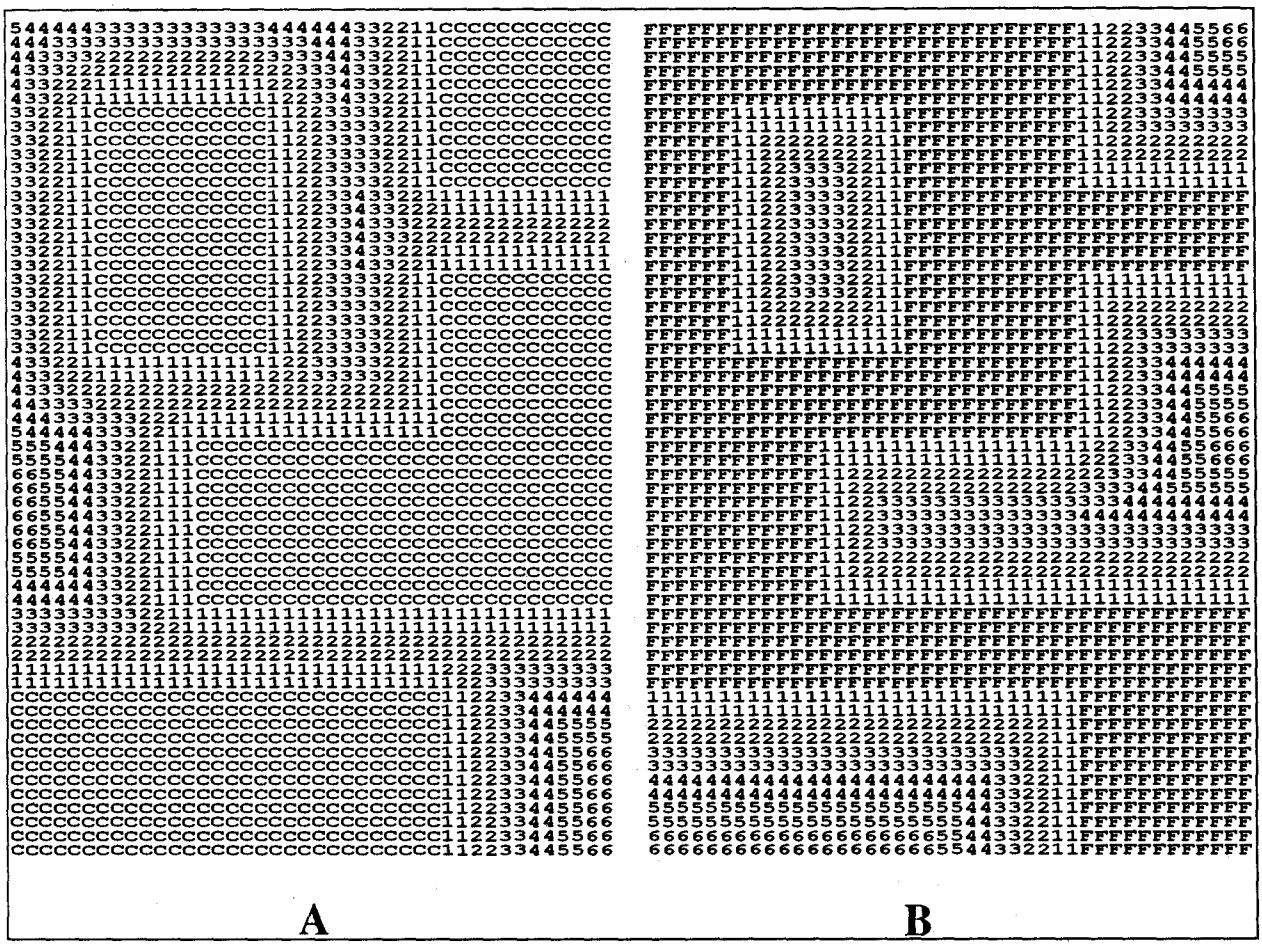

Figure 2—Assignment of distance bands into forage (A) and cover (B) by HEICALC for the map in figure 1. Distance bands are shown by symbols 1 through 6: 1 = 0 to 100 yards; 2 = 101-200 yards; 3 = 201-300; 4 = 301-400; 5 = 401-500; 6 = 501-600. F = forage and C = cover.

The HEf to measure the quantity and quality of forage is measured from two subindexes, HEquant and HEqual. HEICALC uses the following linear equation, derived from the graph presented for the Blue Mountains grassland steppe (Thomas and others 1988) to calculate HEquan:

$$HEquan = (0.0094)(\text{coverage in percent}) + 0.06.$$

Forage quality (HEqual) is based on the weight of forage remaining after October 1. Thomas and others (1988) present a graphic relation between remaining forage weight and remaining forage height; a second graph shows the relation between remaining forage weight and habitat effectiveness. HEICALC combines these graphs to create a table of values directly relating remaining forage height and HEqual (table 2). HEf is calculated as the geometric mean of the forage quantity and quality habitat-effectiveness scores.

Table 2—Species HE quality scores used by HEICALC

Remaining height	Idaho fescue	Bluebunch wheatgrass
Percent	*– – – – HE score – – – –*	
0-4	0.08	0.08
5-14	1.00	.75
15-24	1.00	1.00
25-34	.89	1.00
35-44	.83	.99
45-54	.75	.88
55-64	.70	.84
65-74	.66	.76
>74	.63	.69

The HEc to measure the quality of cover is calculated as the weighted proportion of cover occupied by each habitat type, as described in Thomas and others (1988, p. 17). The proportion of area in each cover type is multiplied by a weighting factor and summed. The weighting factors are 1.0 for satisfactory cover and 0.5 for marginal cover.

A Quick Demonstration

This section provides instructions to demonstrate the HEICALC program and its capabilities. Insert the distribution diskette in the A: drive and type "HEICALC". Press any key after viewing the opening screen. Note the help window, which contains program operation and calculation parameters. The "PgUp" and "PgDn" keys are used to browse through five pages of help information. The "Esc" key is used to close the help window. Press the "/" key to obtain the main menu. Selections from this menu are activated by typing the capitalized letter of each menu option. Load the sample map by selecting the "Map" and "Load" menu options (type "M" and "L"), and then type "SAMPLE.MAP" and press the "Enter" key. The sample map will now be loaded and displayed on the screen. In this map, each code represents a square pixel of 50 yards on a side (0.517 acre). The codes "1" and "3" denote forage and satisfactory cover, respectively. The cursor location can be changed by pressing the four arrow keys. In the lower left corner, the definition of the habitat code is displayed for the current position of the cursor.

The habitat map contains the information required to calculate two of the four habitat parameters-HEs and HEc-which measure the size and spacing of the cover and forage areas and the cover quality. Additional information to calculate the HE for roads can be input for each map. From the menu selections, choose "Options" and "Roads" and enter an open road mileage. Input forage by choosing "Options" and "Forage" from the menu. In this demonstration, we ignore the forage options and let HEICALC use default values included in the program. HEI now can be calculated by choosing "Run" from the main menu. The results will be sent output to the screen (fig. 3) and can be sent to a printer or a file by responding appropriately to the prompts displayed on the lower screen.

Calculation Results For: SAMPLE.MAP

Edge Length = 31500.0 Feet Open Road = 0.0 Miles

Band	Unsuited	Treated	Forage	Marginal	Satisfactory
1-100	0.0	0.0	219.5	0.0	198.9
101-200	0.0	0.0	202.0	0.0	164.8
201-300	0.0	0.0	148.8	0.0	131.2
301-400	0.0	0.0	57.3	0.0	64.6
401-500	0.0	0.0	27.4	0.0	44.9
> 500	0.0	0.0	14.5	0.0	27.9
Total Acres	0.0	0.0	669.4	0.0	632.2
1301.7	0.0%	0.0%	51.4%	0.0%	48.6%

HEs 0.52 | Total HEI
HEr 1.00 | 0.71
HEf 0.50 | HEI - HEf
HEc 1.00 | 0.80

Figure 3—Screen report from HEICALC for SAMPLE.MAP.

To see the "what-if" capabilities of HEICALC for timber sale planning, use the arrow keys to position the cursor within an area of cover habitat (map code "3"). Harvest treatments are applied to habitat maps by changing map codes to "4", either with the keyboard or the mouse. Clicking the left mouse button will change the habitat code at the mouse cursor to the last code entered from the keyboard. HEICALC assumes that treatments in cover areas create forage areas. Each pixel that is changed represents treatment of 0.517 acre. When a harvest unit has been outlined in this manner, run HEICALC again to see changes in the HE that have resulted from the treatments. Each alternative developed in this manner can be saved as a separate habitat map by choosing "Map" and "Save" from the main menu.

To quit HEICALC, choose "Quit" in the main menu.

The HEICALC Command Menu

To activate the main menu in HEICALC, press the "/" key. The complete menu system is shown in figure 4. Select a menu choice by pressing the letter key corresponding to the first letter of each command. The user may exit a menu without selecting a command by pressing the "Esc" key. Selecting a command either causes a program action, displays a submenu, or prompts for user-supplied information. Prompts ending with a question mark generally expect a "yes" or "no" response (the lone exception is the "Options Forage Species" command). Pressing the "Y" key corresponds to a "yes" response; any other key corresponds to a "no" response. Prompts that end with three dots are generally status messages indicating an action that the program is currently executing; however, if such a prompt contains the message "Press any key", the program halts execution until the user completes the action requested and presses any key, thereby signaling the program to continue. Prompts ending with a colon expect the user to type an appropriate response. Some prompts will display a default response.

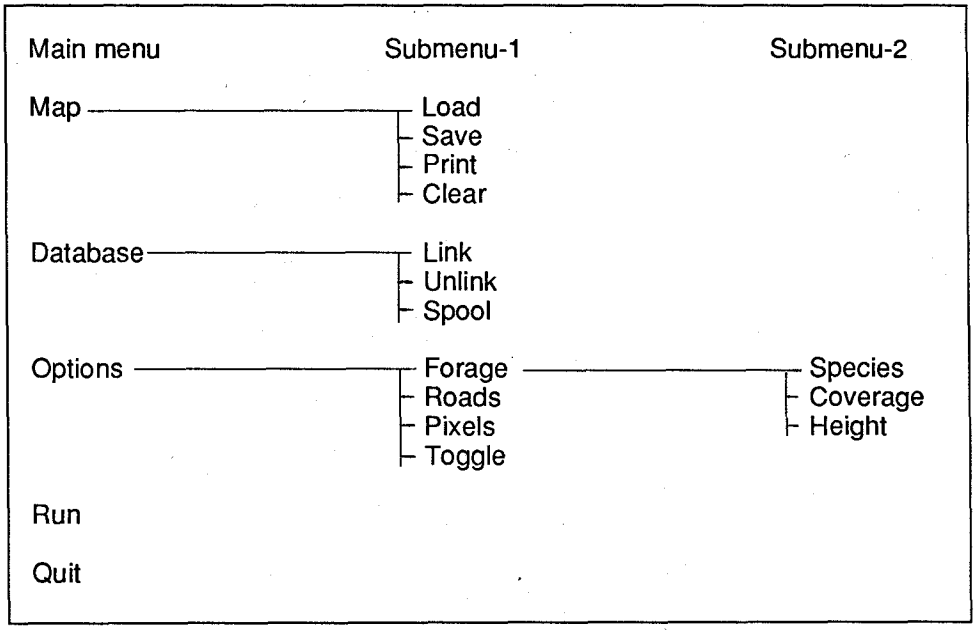

Figure 4—The command menu for the HEICALC program.

Loading, Viewing, Editing, and Printing Maps

The "Map" command is used to toad existing maps, save newly created or changed maps, print maps, and to clear the map display so that a new map can be created. All these operations are accessed on a submenu that appears after the "Maps" command is invoked, as explained below.

Loading maps-The "Load" command reads from an existing habitat maps file. If the specified file name is not found, the prompt for the file name is redisplayed for editing and re-entry. If the specified file name is found, the map display is cleared automatically, an open database will be closed, and the map is loaded into memory. Map files must conform to the standard ASCII convention, commonly referred to as "text files." The ASCII convention calls for an end-of-line sequence (ASCII code 13 followed by ASCII code 10) at the end of each line. In addition, an end-of-file marker (ASCII code 26) must exist at the end of the file. If standard text editors are used to create maps, or the maps are generated with the procedures outlined later in this paper, the map files conform to the ASCII convention. If maps are created with word processors, they must be saved as "text files." When maps are loaded, every character on the line is read, but only the characters corresponding to known habitat codes ("1" through "4", table 1) will appear in the map. Characters and numbers not used by HEICALC (all other numbers and letters in the alphabet) become blanks in the map. If characters with ASCII codes of less than 32 appear in the map (special characters and symbols), they are ignored during the load process, thereby compacting map rows and possibly realigning columns. Any map lines containing more characters than the maximum number of map array columns (600) are truncated. Any map file lines exceeding the maximum number of map array rows are ignored.

Viewing maps-Once a map is loaded, it can be viewed and edited. The location of the highlighted cursor can be changed, within the limits of the map array, by several means. The four arrow keys move the cursor to adjacent pixels. The "PgUp" and "PgDn" keys display the next screen portion of the map above and below, respectively, the current display. Holding the "Ctrl" key down white pressing the right or left arrow displays the next screen portion of the map to the right or left of the current display. Pressing the "Home" key moves the cursor to the upper left corner of the map array, and pressing the "End" key moves the cursor to the bottom right corner of the map. The latter corner is the intersection of the last column and last row containing a habitat code; it is not necessarily equivalent to the bottom right corner of the map array.

Editing maps-Habitat codes contained in the map can be added, changed, or deleted during a viewing session. Pressing any of the keys corresponding to valid habitat codes (table 1) accordingly replaces the contents of the pixel highlighted by the cursor. It also is possible to change habitat codes with a mouse; pressing the left mouse key replaces the pixel contents with the last habitat code typed from the keyboard. Blank pixels can be added to the analysis area by this method, and the contents of any highlighted pixel can be erased by pressing the "Del" key, thereby placing that pixel outside the analysis area.

Saving maps-Maps are saved by using the "Save" command. Maps also can be saved whenever the "Load", "Clear", and "Quit" commands are activated, which automatically prompt the user to save any changes made since the map was last saved. Choosing to save a map with the save command calls the file save process, described as follows. The user is first prompted to specify the name of the map file to save. The map file name must be composed of letters and numbers and can include a file name extension. A drive designator and path also can be specified. If the specified file name is found, a prompt to overwrite the existing file is displayed on the status line. Choosing not to overwrite will redisplay the save file name for editing and re-entry. If a file name is not entered after invoking the "Save" command, the map is not saved, and the program will return to the map display.

Printing maps-The "Print" command sends the current map to an attached printer. The map is printed on numbered pages containing 128 columns and 56 rows with map coordinates in the margins. The printer must be capable of printing 132 characters per line and 60 lines per page. Printers that use only letter-size paper must be set for compressed print mode. The user will be prompted to press any key when the printer is on-line and ready to receive the map. A bell rings to alert the user if printing problems occur.

Clearing the viewing screen-The "Clear" command clears the map array. Once the array is cleared, a new map can be created by entering habitat codes directly. It is not necessary to "Clear" before loading a map file because "Load" also clears the map array. If changes have been made to the current map, the user is prompted to save the current map and the save process is called. "Clear" also will close an open database.

Changing Defaults: Forage, Roads, Pixel Size, and Display

The "Options" command changes HEI calculation default parameters associated with forage quantity and quality, open road miles, and map pixel size. Changes made to default parameters are not saved and must be specified anew with each HEICALC session. Selecting the "Options" command leads to a submenu of the default parameters, as described below.

Forage parameters-The "Forage" command is used to specify the forage species, percentage of cover, and percentage of grass height remaining after October 1. Selecting the "Forage" command leads to a submenu of command choices to specify forage parameters for species, coverage, and height.

The "Species" command allows the user to choose between bluebunch wheatgrass *(Agropyron spicatum)* and Idaho fescue *(Festuca idahoensis)* as the dominant grassland community species within the map analysis area. The default choice is bluebunch wheatgrass. The current species selection is always shown within parentheses at the end of the prompt. Pressing "F" or "B" will select either Idaho fescue or bluebunch wheatgrass as the grassland community type. Pressing "Esc" will return to the map display without changing the current species selection.

The "Coverage" command prompts the user to input the percentage of herbaceous plant cover that is comprised of decreasers. The default is 20 percent, but valid input ranges from 1 to 100 percent. Entering 0 (zero) percent will return the program to the map display without changing the current coverage percentage.

The "Height" command prompts the user to input the percentage of height remaining on the decreaser species on October 1. The default is 30 percent, but valid input ranges from 1 to 100 percent.

Open road mileage-Selecting the "Roads" command prompts the user to input the number of miles of road open to vehicular traffic within the map analysis area. The default is zero, but valid input ranges from 0 to 9999.9 miles. Any valid entry will change the current number of road miles.

Map pixel size-Selecting the "Pixels" command prompts the user to input the number of feet per side of the map pixels. The default is 150 feet, but valid input ranges from 66 to 300 feet. Entering 0 (zero) feet will return the program to the map display without changing the current pixel size.

Display attributes-If an EGA or VGA graphics adapter is installed, the "Toggle" command will appear on the "Options" menu. This option switches the display to 43 (EGA) or 50 (VGA) lines from the standard 25 lines. More of the map can be seen with increased line modes.

Using the Database Feature of HEICALC

HEICALC has a database feature that allows databases to be linked to habitat maps. The "Database" command is used to access an ASCII database file associated with the current map. Each record of the database corresponds to a pixel address and has five 10-character fields containing attributes pertaining to the pixel. Once a database has been linked to the current map, the user can display the attributes of the pixel covered by the highlighted cursor. This feature is useful for associating attributes such as stand numbers with the current map. The user can opt to create a subset of a linked database, which contains records only for those pixels marked as treated areas with habitat code "4". Other database software can then be used to perform calculations on the attribute data associated with pixels marked for treatment. The timber volumes of treated pixels could be summed, for example, to produce an estimate of the harvest volume associated with a particular HEI.

Databases to link with HEICALC must be an ASCII file sorted in order of row (y-coordinate) within column (x-coordinate). The file must end with an end-of-file marker (^Z or ASCII code 26). Each line (record) in the database file must begin with the number 8 and finish with an end-of-line sequence (ASCII codes 13 and 10). In addition, each line must have 56 characters between the number 8 and the end-of-line sequence. The first six characters are the pixel address with which to associate the attribute data; they are followed by five 10-character attribute fields. All attribute fields must exist regardless of usage. Unused fields should be filled with spaces if no data are available. Many types of software, such as database managers, word processors and spreadsheets, can be used to create and maintain a database. But the structure and sorting requirements must be met for the HEICALC software to properly access the associated data.

The required format of the database files is as follows:

Field no.	Field subject	Field width
		Characters
1	Leader "8"	1
2	Column number	3
3	Row number	3
4	Attribute 1	10
5	Attribute 2	10
6	Attribute 3	10
7	Attribute 4	10
8	Attribute 5	10

Selecting the database command leads to a submenu of the commands to link, unlink, and spool databases. These functions are described below.

Linking a database- Databases are linked to a habitat map by using the "Link" command. If a map is currently displayed, selecting the "Link" command prompts the user to specify the name of the database file to link. Any database currently linked to the map closes automatically before linking the newly specified database. The message "F2 Shows Attributes" is displayed on the status line whenever a database is

linked to the current map. Pressing "F2" causes the linked database to be searched for a record corresponding to the address of the pixel covered by the highlighted cursor. If such a record is located, the record attributes are displayed on the status line. Otherwise, the message "Attribute Data Not Found" is displayed. Press any key to clear the status line and return to the current map when finished viewing the displayed attributes.

To demonstrate the database linking procedure, the SAMPLE.DB file on the distribution diskette can be linked to SAM PLE.MAP by using the above procedures. Next, position the cursor on any pixel in the map and press the "F2" key. Attributes from the database are displayed along the bottom of the screen.

Unlinking databases- Databases are unlinked and closed with the "Unlink" command.

Spooling databases- The spooling feature provides a method of reporting the database attributes for all pixels that have had habitat codes changed to treated (habitat code "4"). The user is first prompted to specify the name of the database file to which records are spooled. Entering no file name does not spool the database and instead returns the program to the map display. At the completion of the file spool process, the program returns to the map display.

The spooling feature can be demonstrated with the SAMPLE.DB file on the distribution map. After loading SAMPLE.MAP and linking SAMPLE.DB, change some of the habitat codes to "4", thereby signifying a treatment. Invoke the "Spool" command and enter a file name. Exit the program, and view the spooled data with B.COM program (contained on the distribution diskette) by typing "B filename", where filename is the name given to the spooled data. These data then can be imported to a database used to describe affected resources.

Quitting the Program HEICALC is terminated with the "Quit" command. If changes have been made to the current map since it was last saved, "Quit" prompts the user to save the current map.

Obtaining Habitat Maps for HEICALC Measuring HEI requires maps of forage and cover areas and data on open road mileage, forage quality, and forage quantity. There are many methods for obtaining these data, and, in the case of the cover maps, formatting the data for HEICALC. The following section describes in detail the data type and format requirements for HEICALC. The automated data capture and summary procedures described here are specific to the MOSS-MAPS GIS used by the USDA Forest Service in the Pacific Northwest Region.

There are several ways to obtain cover maps for HEICALC. In all methods, the starting point is a cover map showing polygons of the basic habitat types, forage, and marginal and satisfactory cover. One method for converting these maps into a text file of cover codes is to overlay a Mylar grid constructed so that each pixel corresponds to the selected pixel size (for example 50 by 50 yards, or 0.517 acre) on the cover map, and code the value of each pixel directly on the Mylar. The codes are typed directly into an ASCII file with any editor. Mylar grids can be generated with CAD software.

With GIS (MOSS-MAPS) software, cover maps can be digitized, rasterized (converted to a pixel map), and exported. In MOSS, vector (line) maps are converted to raster format with the "Polycell" command and choosing "Subject Number Assignment". Maps should be polycelled to a pixel size of 25, 50, or 100 yards on a side. Our testing indicates that a pixel size of 50 by 50 yards (0.517 acre) produces good resolution and minimizes errors in the raster process. When prompted by MOSS in the polycell process, enter 0.517 acre with a pixel ratio of 1. The map type is "Discrete", "Type 7", and pixels are assigned by "Subject Number" (option 5).

Exporting the map is most easily accomplished with the MOSS "SPSS" command, which produces an ASCII data file containing row, column, and map subject. This same technique can be used to generate databases to link with habitat maps. When prompted in the SPSS procedure whether to eliminate empty cases, choose "yes". After downloading to the microcomputer, this file is processed with HEIUTIL.EXE program distributed with HEICALC to regenerate the map. The polycelled map should be examined to ensure that MOSS assigned values to map subjects according to the format required by HEICALC (see table 1). To determine if the map requires recoding, examine the raster map subjects by using the "Describe" command. If subjects are incorrectly coded, they can be recoded within the HEICALC program.

Optimal Pixel Size for Habitat Maps

HEICALC can process maps having pixels between 0.1 and 2.066 acres. The maximum size of 2.066 acres is determined by the distance bands in the HEI model being in increments of 100 yards, and a 100-yard-square pixel is 2.066 acres. For HEICALC to function as intended, pixels should have dimensions evenly divisible into 100 (for example, 25 or 50 yards). Thus the optimum pixel sizes are either 25, 50, or 100 yards on a side, which corresponds to 0.129, 0.517, and 2.066 acres, respectively. Our tests with cover maps of winter range in the Blue Mountains showed that a pixel size of 0.517 acre is the most efficient scale. Larger pixel sizes (for example, 2.066 acres) resulted in a loss of small "stringers" of cover during the polycell process in MOSS. These small cover areas may not be significant in terms of elk habitat use (see Thomas and others 1988), but we believe their deletion from the habitat map should be performed by wildlife biologists rather than by GIS software. In addition, with 100- by 100-yard pixels, the diagonal distance between pixels centers is 141.42 yards, and thus habitat comparisons between diagonal pixels contribute to the 101- to 200-yard spacing band. These problems are largely nonexistent with pixel sizes of 0.517 or 0.129 acre. The only problem with using a smaller pixel size is that map arrays become somewhat large and processing time is increased.

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National Forests in the Pacific Northwest Region have incorporated elk habitat standards into Forest plans to ensure that elk habitat objectives are met on multiple use land allocations. Many Forests have employed versions of the habitat effectiveness index (HEI) as a standard method to evaluate habitat. Field application of the HE] model unfortunately is a formidable problem, owing largely to the detailed calculations of "spacing bands" that describe the spatial arrangement of forage and cover areas. This paper describes a DOS microcomputer program that automates the calculation of HEI. "HEICALC" is a simple, menu-driven program that will run on virtually any DOS microcomputer. HEICALC vastly simplifies the task of measuring elk habitat conditions over large areas. It is especially useful in projects where several management alternatives are evaluated for their effects on elk habitat. A floppy diskette containing a copy of the program is distributed with the publication.

Keywords: Elk habitat, HEI, wildlife software, Blue Mountains.

Pacific Northwest Research Station 333 S.W. First Avenue P.O. Box 3890 Portland, Oregon 97208-3890

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