SPATIAL DISTRIBUTION OF MINNESOTA'S
MAITRE HARDWOOD INVENTORY FOR

by

James T. Williams, Eric Smith and Dietmar W. Rose

STAFF PAPER SERIES NUMBER 29

---

1 The authors are Research Assistants and Professor, Department of
Forest Resources, College of Forestry, University of Minnesota.

Staff Papers are published without formal review within the Department
of Forest Resources.
INTRODUCTION

Recent inventory records for Minnesota indicate vast quantities of mature aspen and other hardwoods (Jakes, 1980). This surplus growing stock volume was clearly one contributing factor in the emergence of Minnesota's waferboard industry as well as the increasing use of wood for energy. Both of these uses are putting increasing pressure on the hardwood, especially aspen, resource. To properly understand the potential and the limitations of the resource, an analysis of the inventory as well as its distribution in relation to major markets was performed.

Recently, attempts have been made to estimate the effect of forest location and transport system distribution on returns to both wood users and landowners. From the standpoint of creating supply, the distribution of the transport net is a key determinant of which lands can yield a return from current harvests or future forest investments. From the standpoint of industrial expansion, a mill must have a good idea of how the transport infrastructure will affect its delivered wood costs now and in the future.

Objectives

The primary objective of this report is the analysis of the 1977 U.S. Forest Service inventory of permanent plots in Minnesota. The road transport distance and cost from the forest resource to major markets is analyzed for mature aspen and hardwoods.
Methods

A computerized process that permits the automatic calculation of transport distance and cost from any inventory plot to any market in Minnesota was utilized to develop estimates of physical timber supply (Rose et al., 1982). Using a growth projection system (Ek, Rose and Checky, 1980), these physical supply estimates were developed for the years 1980, 1990, 2000, and 2010. A method was developed for presenting the data in tabular form with respect to each market.

The work consisted of two stages, data preparation and data analysis. In the first stage, the following pieces of information were collected and subjected to preliminary computation:

a) A list of existing and likely future market locations for which to calculate supply was established based on knowledge of timber processing activities in the state. The following list of ten markets includes the major hardwood timber processors in pulp and paper, waferboard and major sawmilling activities:

- International Falls
- Cloquet
- Grand Rapids
- Bemidji
- Cook
- Sartell
- Big Fork
- Virginia
- Isabella
- Brainerd

The locations of these markets are shown in Figure 1.
Figure 1. Location of existing and potential markets.

- Existing market
- Potential market
b) Permanent plot inventory data from the 1977 survey of all Minnesota forest lands conducted by the U.S. Forest Service were compiled in a plot masterfile for subsequent computer analysis. The plots represent county-wide inventory aggregation with respect to a multi-way classification of ownership, covertype, and age classes. In addition, an individual tree-based growth model was used to obtain plot data for future stands. The projection years for this study were 1980, 1990, 2000 and 2010. Since no harvesting activities were simulated, successive plot data included mature stands from previous projection years in addition to stands that reached maturity by the projection year.

c) A set of timber hauling distances between each plot and each specified market in the state was calculated. This information was added to the plot masterfile.

The major component of the hauling distance calculation is a matrix of transportation distances between 2062 locations (population centroids) in Minnesota, obtained from the Minnesota Department of Transportation. The final total hauling distance from a stand (plot) to a market was calculated from:

1) distance from the road nearest the stand to the nearest centroid (stand centroid);

2) distance from that centroid to the centroid nearest a specific market (market centroid);

3) distance from the market centroid to the market itself.

The sum of these three distances comprised the total hauling distance.
In the data analysis stage, a pair of computer programs developed for this study were used to analyze the plot data. The first program screened the plot lists to select the plots of interest to this study, and estimated transportation and harvesting costs to the selected markets within the state. The second program developed a set of physical volume distributions for each specified market. Distribution by distance is the simplest measure of competitive advantage of markets (Bradley, 1972). Each market was treated as if it were the only market in the timbershed and all timber volumes were available to it.

With the emphasis of the study on opportunities for integrating the use of hardwoods for traditional forest industry and for energy in Minnesota, specific plot characteristics were of primary interest. The following schedule indicates the plot types selected for the analysis.

(a) 4 ownerships
   - U.S. Forest Service
   - State
   - other public
   - private

(b) 2 coverted types
   - aspen
   - other hardwoods

(c) 1 age class: 50 years and older

A listing of the first computer program is contained in Appendix B.

Tables I and II illustrate the proportion of the total hardwood resource involved in the study (Jakes, 1980).

---

1 Age specification is with respect to midpoints of 10-year age class classifications. Thus, a 50-year old specification in 1980 might include stands as young as 45 years old and exclude stands as old as 54 years old.
Table I. Commercial forest acreage (in 1,000 acres)

<table>
<thead>
<tr>
<th></th>
<th>Aspen</th>
<th>Other Hardwoods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>5,302</td>
<td>4,462</td>
</tr>
<tr>
<td>&gt; 50 years</td>
<td>2,725 (51%)</td>
<td>3,391 (76%)</td>
</tr>
</tbody>
</table>

Table II. Net growing stock volume (in 1,000 cords)

<table>
<thead>
<tr>
<th></th>
<th>Aspen</th>
<th>Other Hardwoods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>59,265</td>
<td>49,662</td>
</tr>
<tr>
<td>&gt; 50 years</td>
<td>41,847 (71%)</td>
<td>43,297 (87%)</td>
</tr>
</tbody>
</table>

A regression model reflected transportation costs as a function of hauling distance and truck type. Typically for shorter hauls, a smaller, self-loading truck is used. Longer hauls (approximately greater than 40 miles) are normally handled by larger trucks that have wood transferred to them via smaller trucks emerging from the woods.  

The regression model was derived from transportation cost data from the Minnesota Department of Natural Resources (1980). To maintain continuity of the cost function, a break was located at a distance of 37 miles. The model is described as follows:

For $D \geq 37$ miles:  $\hat{T} = 1.16326 + .112016 D$

For $D < 37$ miles:  $\hat{T} = 4.21878 + .030418 D$

---

2 Personal communication with several Minnesota industry procurement personnel, August, 1981.
where

\[ T = \text{transportation cost (\$/cord)} \]

\[ D = \text{hauling distance from plot to market (miles)} \]

Harvesting costs were also estimated via regression analysis. The model reflected roundwood harvesting costs as a function of average basal area per tree and roundwood volume per acre. Cost data were obtained from the Minnesota Department of Natural Resources (1980). Road building costs were not considered in the study, due to lack of sufficient cost data. The model is described as follows:

\[ \hat{H} = 24.1172 + 0.96595 A^{-1} + 10.753 B^{-1} + 3.9068 C \]

where

\[ H = \text{harvesting cost (\$/cord)} \]

\[ A = \text{average basal area per tree (ft}^2\) \geq 5 \text{ in. dbh} \]

\[ B = \text{roundwood volume per acre (cords) \geq 5 \text{ in. dbh} }\]

\[ C = BA^{-1} \text{ (interaction component)} \]

The second computer program organized the screened plot data and presented it in tabular form for each market. Each table shows four distinct product types separately for the two species types of aspen (\textit{Populus tremuloides} Michx. and \textit{Populus grandidentata} Michx.) and non-aspen hardwoods, within a given ownership, covertype and age class. A listing of the second computer program is contained in Appendix C.
The tables can be generated in two styles of distance or cost classes, a discrete style and a cumulative style. Appendix D contains examples of the discrete tables in which each class represents only that volume explicitly within that distance/cost segment. In the cumulative style (see below) each class represents its own volume plus volumes of all previous classes.

Two complete sets of tables were generated for this study according to the stand type schedule described above. The first set contains 320 cumulative distance class tables, and the second set contains 320 cumulative cost class tables. Both sets are available on microfiche format (as Appendix E) from the College of Forestry for a small processing fee.

Several summaries of the tables were made for each of the four product types within 50 miles of market:

(a) pulpwood and sawbolt volumes
(b) sawlog volumes
(c) harvestable biomass
(d) residual biomass

---

3 Product type definitions (all adjusted for defect):

(a) pulpwood and sawbolts: material 100 inches long with top dib \( \geq 3.5 \) inches but \( < 10.0 \) inches.
(b) sawlogs: material 100 inches long with top dib \( \geq 10 \) inches
(c) harvestable biomass: mainstem, branches and bark of trees \( \geq 5 \) inches dbh
(d) residual biomass: 30\% of the aspen harvestable biomass plus 100\% of the other hardwood harvestable biomass.
Contained in Appendix A, the summaries further aggregate the volumes over the four ownership categories within each of the two coverted types, aspen and other hardwoods.

Two types of trends are apparent from the summaries. First, volumes for certain market areas tend to shift between product classes (say, from the pulpwood-sawbolo class to the sawlog class) over time. Second, stand coverted type classifications may change over time, reflecting a shift of species types with a predominant proportion of stand basal area. This causes the associated volumes to be classified within a different coverted type category.

A final observation points out that setting a minimum stand age for analysis may promote substantial ingrowth into the acceptable age class. The intent of the summaries is to serve as a broad guide to general movement tendencies of the timber volumes with respect to their age class distributions and relative stand composition.

The effects of harvesting will, of course, change the actual results in later time periods. Additional work is being performed to simulate the interactions of supply and market demands over time.
LITERATURE CITED


APPENDIX A

Volume Distribution Summaries by Distance Class
Table 1. Pulpwood and sawbark volumes within 50 miles of market; aspen coverytype ≥ 50 years; all ownerships (in 1,000 cords).

<table>
<thead>
<tr>
<th>Class</th>
<th>1980</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Aspen</td>
<td>Other</td>
<td>Aspen</td>
<td>Other</td>
<td>Aspen</td>
<td>Other</td>
<td>Aspen</td>
<td>Other</td>
<td>Aspen</td>
<td>Other</td>
<td>Other</td>
</tr>
<tr>
<td>Int'l. Falls</td>
<td>1307.9</td>
<td>291.9</td>
<td>1594.0</td>
<td>472.1</td>
<td>1618.8</td>
<td>575.3</td>
<td>1447.1</td>
<td>574.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cloquet</td>
<td>1486.7</td>
<td>674.2</td>
<td>1932.7</td>
<td>1379.1</td>
<td>2124.8</td>
<td>1674.7</td>
<td>2083.3</td>
<td>1549.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grand Rapids</td>
<td>4048.6</td>
<td>1333.6</td>
<td>3854.7</td>
<td>2697.0</td>
<td>3554.0</td>
<td>3255.5</td>
<td>2693.1</td>
<td>2966.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bemidji</td>
<td>3377.2</td>
<td>1635.4</td>
<td>4535.8</td>
<td>3062.2</td>
<td>4175.7</td>
<td>3616.4</td>
<td>3254.7</td>
<td>3298.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cook</td>
<td>4144.7</td>
<td>1259.3</td>
<td>3829.2</td>
<td>1441.0</td>
<td>3313.2</td>
<td>1650.4</td>
<td>2354.6</td>
<td>1506.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sartell</td>
<td>163.6</td>
<td>157.7</td>
<td>306.5</td>
<td>211.0</td>
<td>382.6</td>
<td>266.1</td>
<td>347.4</td>
<td>304.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Big Fork</td>
<td>2631.6</td>
<td>731.3</td>
<td>2948.4</td>
<td>1105.5</td>
<td>2904.4</td>
<td>1485.3</td>
<td>2342.2</td>
<td>1444.1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Virginia</td>
<td>3309.0</td>
<td>1068.9</td>
<td>3155.7</td>
<td>1585.4</td>
<td>2740.9</td>
<td>1774.6</td>
<td>2029.2</td>
<td>1531.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isabella</td>
<td>1293.5</td>
<td>711.0</td>
<td>813.1</td>
<td>469.3</td>
<td>556.7</td>
<td>346.8</td>
<td>411.9</td>
<td>441.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brainerd</td>
<td>1888.8</td>
<td>1254.9</td>
<td>2327.2</td>
<td>2142.4</td>
<td>2420.5</td>
<td>2568.0</td>
<td>1876.7</td>
<td>2367.6</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 2. Sawlog volumes within 50 miles of market; aspen covertype ≥ 50 years; all ownerships (in 1,000 cords).

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Aspen</td>
<td>Other</td>
<td>Aspen</td>
<td>Other</td>
</tr>
<tr>
<td>Int'l. Falls</td>
<td></td>
<td>388.3</td>
<td>27.1</td>
<td>1577.3</td>
<td>230.6</td>
</tr>
<tr>
<td>Cloquet</td>
<td></td>
<td>380.4</td>
<td>74.7</td>
<td>2245.8</td>
<td>572.6</td>
</tr>
<tr>
<td>Grand Rapids</td>
<td></td>
<td>1343.2</td>
<td>186.2</td>
<td>5424.0</td>
<td>1187.7</td>
</tr>
<tr>
<td>Bemidji</td>
<td></td>
<td>997.4</td>
<td>301.6</td>
<td>4980.3</td>
<td>1574.3</td>
</tr>
<tr>
<td>Cook</td>
<td></td>
<td>3185.5</td>
<td>103.0</td>
<td>4164.0</td>
<td>649.4</td>
</tr>
<tr>
<td>Sartell</td>
<td></td>
<td>32.3</td>
<td>65.0</td>
<td>267.5</td>
<td>213.8</td>
</tr>
<tr>
<td>Big Fork</td>
<td></td>
<td>970.5</td>
<td>142.8</td>
<td>3994.3</td>
<td>589.1</td>
</tr>
<tr>
<td>Virginia</td>
<td></td>
<td>895.7</td>
<td>68.3</td>
<td>3349.3</td>
<td>551.8</td>
</tr>
<tr>
<td>Isabella</td>
<td></td>
<td>306.6</td>
<td>9.7</td>
<td>824.5</td>
<td>167.9</td>
</tr>
<tr>
<td>Brainerd</td>
<td></td>
<td>660.2</td>
<td>271.5</td>
<td>2788.8</td>
<td>1209.8</td>
</tr>
</tbody>
</table>
Table 3. Harvestable biomass within 50 miles of market; aspen covertype ≥ 50 years; all ownerships (in 1,000 dry tons).

<table>
<thead>
<tr>
<th>Class</th>
<th>1980</th>
<th>1990</th>
<th>2000</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Aspen</td>
<td>Hardwoods</td>
<td>Aspen</td>
<td>Hardwoods</td>
</tr>
<tr>
<td>Market</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Int'l. Falls</td>
<td>3097.1</td>
<td>7295.6</td>
<td>5798.3</td>
<td>1551.3</td>
</tr>
<tr>
<td>Cloquet</td>
<td>3383.9</td>
<td>1742.5</td>
<td>7676.1</td>
<td>4458.6</td>
</tr>
<tr>
<td>Grand Rapids</td>
<td>9822.5</td>
<td>3580.6</td>
<td>17282.6</td>
<td>8848.5</td>
</tr>
<tr>
<td>Bemidji</td>
<td>8014.7</td>
<td>4552.5</td>
<td>17540.9</td>
<td>10744.8</td>
</tr>
<tr>
<td>Cook</td>
<td>10200.9</td>
<td>3144.0</td>
<td>14788.6</td>
<td>4685.2</td>
</tr>
<tr>
<td>Sartell</td>
<td>356.6</td>
<td>519.3</td>
<td>1040.1</td>
<td>1024.8</td>
</tr>
<tr>
<td>Big Fork</td>
<td>6626.6</td>
<td>1980.6</td>
<td>12947.6</td>
<td>3771.1</td>
</tr>
<tr>
<td>Virginia</td>
<td>7654.4</td>
<td>2620.6</td>
<td>11951.9</td>
<td>4824.2</td>
</tr>
<tr>
<td>Isabella</td>
<td>2911.7</td>
<td>1722.5</td>
<td>3026.9</td>
<td>1474.2</td>
</tr>
<tr>
<td>Brainerd</td>
<td>4689.8</td>
<td>3660.5</td>
<td>9467.9</td>
<td>8014.1</td>
</tr>
</tbody>
</table>
Table 4. Residual biomass within 50 miles of market; aspen coverts for ≥ 50 years; all ownerships (in 1,000 dry tons).

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Int'l. Falls</td>
<td>1658.7</td>
<td>3290.8</td>
<td>4412.5</td>
<td>4970.9</td>
</tr>
<tr>
<td>Cloquet</td>
<td>2757.6</td>
<td>6761.4</td>
<td>9730.6</td>
<td>10893.8</td>
</tr>
<tr>
<td>Grand Rapids</td>
<td>6527.4</td>
<td>14033.3</td>
<td>18319.1</td>
<td>19152.2</td>
</tr>
<tr>
<td>Bemidji</td>
<td>6957.0</td>
<td>16007.1</td>
<td>20873.8</td>
<td>22215.3</td>
</tr>
<tr>
<td>Cook</td>
<td>6204.3</td>
<td>9121.8</td>
<td>11152.9</td>
<td>11318.7</td>
</tr>
<tr>
<td>Sartell</td>
<td>626.3</td>
<td>1336.9</td>
<td>1889.2</td>
<td>2505.0</td>
</tr>
<tr>
<td>Big Fork</td>
<td>3968.6</td>
<td>7655.4</td>
<td>10786.2</td>
<td>12043.6</td>
</tr>
<tr>
<td>Virginia</td>
<td>4916.9</td>
<td>8409.7</td>
<td>10414.1</td>
<td>10274.2</td>
</tr>
<tr>
<td>Isabella</td>
<td>2596.0</td>
<td>2382.3</td>
<td>2136.6</td>
<td>3092.1</td>
</tr>
<tr>
<td>Brainerd</td>
<td>5067.5</td>
<td>10854.5</td>
<td>14553.6</td>
<td>15697.6</td>
</tr>
</tbody>
</table>
Table 5. Pulpwood and sawbalk volumes within 50 miles of market; other hardwood coventional > 50 years; all ownerships (in 1,000 cords).

<table>
<thead>
<tr>
<th>Class</th>
<th>1980</th>
<th></th>
<th></th>
<th>1990</th>
<th></th>
<th></th>
<th>2000</th>
<th></th>
<th></th>
<th>2010</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Aspen</td>
<td>Other</td>
<td></td>
<td>Aspen</td>
<td>Other</td>
<td></td>
<td>Aspen</td>
<td>Other</td>
<td></td>
<td>Aspen</td>
<td>Other</td>
<td></td>
</tr>
<tr>
<td>Int'l. Falls</td>
<td>301.2</td>
<td>597.9</td>
<td></td>
<td>107.5</td>
<td>665.9</td>
<td></td>
<td>104.3</td>
<td>929.9</td>
<td></td>
<td>139.8</td>
<td>1209.4</td>
<td></td>
</tr>
<tr>
<td>Cloquet</td>
<td>724.5</td>
<td>3630.3</td>
<td></td>
<td>629.5</td>
<td>5864.3</td>
<td></td>
<td>612.6</td>
<td>7509.3</td>
<td></td>
<td>580.1</td>
<td>8514.1</td>
<td></td>
</tr>
<tr>
<td>Grand Rapids</td>
<td>837.1</td>
<td>5348.3</td>
<td></td>
<td>599.6</td>
<td>7350.0</td>
<td></td>
<td>674.5</td>
<td>9053.4</td>
<td></td>
<td>682.1</td>
<td>10049.1</td>
<td></td>
</tr>
<tr>
<td>Bemidji</td>
<td>811.0</td>
<td>3538.7</td>
<td></td>
<td>566.6</td>
<td>5146.1</td>
<td></td>
<td>669.4</td>
<td>6637.8</td>
<td></td>
<td>706.5</td>
<td>7670.4</td>
<td></td>
</tr>
<tr>
<td>Cook</td>
<td>568.2</td>
<td>1564.6</td>
<td></td>
<td>510.8</td>
<td>2993.4</td>
<td></td>
<td>446.3</td>
<td>3669.9</td>
<td></td>
<td>401.7</td>
<td>4673.8</td>
<td></td>
</tr>
<tr>
<td>Sartell</td>
<td>239.7</td>
<td>2636.0</td>
<td></td>
<td>256.5</td>
<td>3171.4</td>
<td></td>
<td>237.5</td>
<td>3665.8</td>
<td></td>
<td>190.6</td>
<td>3738.3</td>
<td></td>
</tr>
<tr>
<td>Big Fork</td>
<td>622.2</td>
<td>2716.8</td>
<td></td>
<td>314.5</td>
<td>3202.5</td>
<td></td>
<td>363.5</td>
<td>3972.4</td>
<td></td>
<td>381.0</td>
<td>4363.0</td>
<td></td>
</tr>
<tr>
<td>Virginia</td>
<td>505.8</td>
<td>1708.3</td>
<td></td>
<td>404.5</td>
<td>3247.4</td>
<td></td>
<td>362.2</td>
<td>3973.5</td>
<td></td>
<td>376.8</td>
<td>4857.1</td>
<td></td>
</tr>
<tr>
<td>Isabella</td>
<td>511.1</td>
<td>2910.3</td>
<td></td>
<td>602.3</td>
<td>4180.7</td>
<td></td>
<td>523.2</td>
<td>4855.4</td>
<td></td>
<td>403.7</td>
<td>5434.4</td>
<td></td>
</tr>
<tr>
<td>Brainerd</td>
<td>589.7</td>
<td>4702.0</td>
<td></td>
<td>578.8</td>
<td>6978.0</td>
<td></td>
<td>623.0</td>
<td>8700.0</td>
<td></td>
<td>575.5</td>
<td>9576.2</td>
<td></td>
</tr>
</tbody>
</table>
Table 6. Sawlog volumes within 50 miles of market; other hardwood covertype ≥ 50 years; all ownerships (in 1,000 cords).

<table>
<thead>
<tr>
<th>Class</th>
<th>1980 Other Aspen</th>
<th>1990 Other Aspen</th>
<th>2000 Other Aspen</th>
<th>2010 Other Aspen</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Aspen Hardwoods</td>
<td>Aspen Hardwoods</td>
<td>Aspen Hardwoods</td>
<td>Aspen Hardwoods</td>
</tr>
<tr>
<td>Int'l. Falls</td>
<td>136.3</td>
<td>226.0</td>
<td>151.7</td>
<td>582.1</td>
</tr>
<tr>
<td>Cloquet</td>
<td>204.7</td>
<td>745.3</td>
<td>758.2</td>
<td>3304.5</td>
</tr>
<tr>
<td>Grand Rapids</td>
<td>452.0</td>
<td>1581.4</td>
<td>1059.9</td>
<td>5483.3</td>
</tr>
<tr>
<td>Bemidji</td>
<td>374.0</td>
<td>997.1</td>
<td>857.3</td>
<td>3649.7</td>
</tr>
<tr>
<td>Cook</td>
<td>227.6</td>
<td>149.0</td>
<td>670.9</td>
<td>1060.4</td>
</tr>
<tr>
<td>Sartell</td>
<td>67.6</td>
<td>1944.1</td>
<td>268.6</td>
<td>4391.9</td>
</tr>
<tr>
<td>Big Fork</td>
<td>331.6</td>
<td>806.2</td>
<td>522.0</td>
<td>2712.0</td>
</tr>
<tr>
<td>Virginia</td>
<td>177.1</td>
<td>172.4</td>
<td>542.3</td>
<td>1257.6</td>
</tr>
<tr>
<td>Isabella</td>
<td>255.0</td>
<td>770.0</td>
<td>591.3</td>
<td>2356.3</td>
</tr>
<tr>
<td>Brainerd</td>
<td>202.6</td>
<td>1868.1</td>
<td>890.1</td>
<td>6157.7</td>
</tr>
</tbody>
</table>
Table 7. Harvestable biomass within 50 miles of market; other hardwood cover type ≥ 50 years; all ownerships (in 1,000 dry tons).

<table>
<thead>
<tr>
<th>Class</th>
<th>1980</th>
<th></th>
<th>1990</th>
<th></th>
<th>2000</th>
<th></th>
<th>2010</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Market</td>
<td>Aspen Hardwoods</td>
<td>Aspen Hardwoods</td>
<td>Aspen Hardwoods</td>
<td>Aspen Hardwoods</td>
<td>Aspen Hardwoods</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Int'l. Falls</td>
<td>826.3 1793.1</td>
<td>502.0 2736.7</td>
<td>612.6 4083.8</td>
<td>896.3 5763.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cloquet</td>
<td>1694.4 9938.2</td>
<td>2547.6 20626.8</td>
<td>3526.4 30211.9</td>
<td>4637.6 40049.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grand Rapids</td>
<td>2453.6 15437.9</td>
<td>3236.1 28276.1</td>
<td>4624.0 39364.8</td>
<td>5988.9 50469.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bemidji</td>
<td>2288.9 10296.9</td>
<td>2699.1 19599.3</td>
<td>3961.5 28827.6</td>
<td>5171.6 38279.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cook</td>
<td>1485.7 3913.6</td>
<td>2210.7 9137.5</td>
<td>2578.8 12599.9</td>
<td>3233.7 17868.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sartell</td>
<td>561.5 10640.8</td>
<td>972.5 17499.3</td>
<td>1316.1 23228.3</td>
<td>1402.0 27697.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Big Fork</td>
<td>1804.9 7686.9</td>
<td>1622.0 12788.8</td>
<td>2215.4 17998.0</td>
<td>2669.8 22793.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Virginia</td>
<td>1264.3 4309.2</td>
<td>1769.2 10134.2</td>
<td>2149.0 13980.3</td>
<td>3021.9 19443.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isabella</td>
<td>1439.8 8877.1</td>
<td>2218.6 15452.0</td>
<td>2524.2 19407.3</td>
<td>2749.1 23485.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brainerd</td>
<td>1465.4 15389.6</td>
<td>2783.3 30337.9</td>
<td>4108.5 42839.7</td>
<td>5037.2 54371.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 8. Residual biomass within 50 miles of market; other hardwood covertype ≥ 50 years; all ownerships (in 1,000 dry tons).

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Int'l. Falls</td>
<td>2041.0</td>
<td>2887.3</td>
<td>4267.6</td>
<td>6032.3</td>
</tr>
<tr>
<td>Cloquet</td>
<td>10446.5</td>
<td>21391.1</td>
<td>31269.8</td>
<td>41440.9</td>
</tr>
<tr>
<td>Grand Rapids</td>
<td>16174.0</td>
<td>29246.9</td>
<td>40752.0</td>
<td>52266.5</td>
</tr>
<tr>
<td>Bemidji</td>
<td>10965.6</td>
<td>20409.0</td>
<td>30016.1</td>
<td>39830.8</td>
</tr>
<tr>
<td>Cook</td>
<td>4359.3</td>
<td>9800.7</td>
<td>13373.5</td>
<td>18838.8</td>
</tr>
<tr>
<td>Sartell</td>
<td>10809.3</td>
<td>17791.1</td>
<td>23623.1</td>
<td>28118.1</td>
</tr>
<tr>
<td>Big Fork</td>
<td>8228.4</td>
<td>13275.4</td>
<td>18662.6</td>
<td>23594.6</td>
</tr>
<tr>
<td>Virginia</td>
<td>4688.5</td>
<td>10665.0</td>
<td>14625.0</td>
<td>20349.6</td>
</tr>
<tr>
<td>Isabella</td>
<td>9309.0</td>
<td>16117.6</td>
<td>20164.6</td>
<td>24310.2</td>
</tr>
<tr>
<td>Brainerd</td>
<td>15829.2</td>
<td>31172.9</td>
<td>44072.3</td>
<td>55882.7</td>
</tr>
</tbody>
</table>
APPENDIX B:

Source Code Listing of First Computer Program
PROGRAM SCREEN (INPUT, OUTPUT, TAPE1, TAPE3, TAPE7, TAPE8)

** PROGRAM IDENTIFICATION **

***

THIS PROGRAM READS THE PLOT SUMMARY MASTERFILE AND SCREENS
PLOTS ACCORDING TO OWNERSHIP, COVERTYPE, AND AGE CLASSES.
INPUT IS READ FROM TAPE1, A USER-SPECIFIED PARAMETER FILE,
AND TAPE3, THE PLOT DATA. IN ADDITION, TRANSPORTATION
DISTANCE DATA IS LOCATED ON FILE DISTMAST. IT IS A WORD-
ADDRESSABLE RANDOM-ACCESS FILE CREATED BY PROGRAM CREATMA.
OUTPUT FILES ARE TAPE7 AND TAPE8. TAPE7 IS USED FOR THE
SUPPLY ANALYSIS PROGRAMS. TAPE8 IS USED IN THE OPTIONAL
EXTERNAL PLOTTING ROUTINE.

***

INTERNALLY DOCUMENTED SUBROUTINES

***

AGGOWN: ASSIGNS A PLOT'S DISCRETE OWNERSHIP CLASS TO
THE MOST AGGREGATIVE QUALIFYING USER-SPECIFIED
OWNERSHIP ANALYSIS CLASS

DEFWO: ASSIGNS A PLOT'S DISCRETE OWNERSHIP CLASS TO
THE QUALIFYING USER-DEFINED OWNERSHIP
ANALYSIS CLASS

AGGCOV: ASSIGNS A PLOT'S DISCRETE COVERTYPE CLASS TO
THE MOST AGGREGATIVE QUALIFYING USER-SPECIFIED
COVERTYPE ANALYSIS CLASS

DEFCOV: ASSIGNS A PLOT'S DISCRETE COVERTYPE CLASS TO
THE QUALIFYING USER-DEFINED COVERTYPE
ANALYSIS CLASS

***

VARIABLE IDENTIFICATION

***

<table>
<thead>
<tr>
<th>NAME</th>
<th>TYPE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACRES</td>
<td>I VAR</td>
<td>PLOT EXPANSION FACTOR (CONVERTED FROM IP(22))</td>
</tr>
<tr>
<td>AGE</td>
<td>I VAR</td>
<td>AGE OF A PLOT (CONVERTED FROM IP(15))</td>
</tr>
<tr>
<td>BAA5X</td>
<td>R VAR</td>
<td>BASAL AREA PER ACRE FOR ALL TREES .GE. 5 INCHES DBH</td>
</tr>
</tbody>
</table>
AN ORDERED COUNTY BETWEEN INVENTORY UNITS

SPECIES AGGREGATE COMBINATION TABLE (JCOMB)

AN INDICATOR FLAG IN SUBROUTINE AGSCOV IF COVTYPE IS NOT AGGREGATED

AN INDICATOR FLAG IN SUBROUTINE DEFSCOV IF THE PLOT DOES NOT AGREE WITH THE COVCOMB(NSUBCOV)

CODES FOR EACH OF ISUBCOV COVERTYPE SUBCLASSES

CODES FOR EACH OF ICOV COVERTYPE CLASSES

THE REASSIGNED SCREEN COVERTYPE CLASS

TOTAL ROUNDWOOD VOLUME (CUBIC FEET PER ACRE)

DISTANCE ON ROAD TO TOWNSHIP CENTROID (EQUIVALENT TO IP(7))

DISTANCES BETWEEN STAND AND MARKET CENTROIDS

HARVEST COST PER CORD (TREE-LENGTH SKID TO BUCK AT LANDING)

NUMBER OF SCREEN COVERTYPE CLASSES TO BE ANALYZED (LIMIT = 14)

REASSIGNED COUNTY NUMBER (BETWEEN INVENTORY UNITS)

NUMBER OF SCREEN OWNERSHIP CLASSES TO BE ANALYZED (LIMIT = 13)

PARAMETER INFORMATION READ FROM PLOT SUMMARY

MASTERFILE:

IP(1) = INVENTORY UNIT
IP(2) = COUNTY (WITHIN AN INVENTORY UNIT)
IP(3) = YEAR OF SURVEY
IP(4) = PLOT NUMBER (WITHIN AN INVENTORY UNIT)
IP(5) = TOWNSHIP, RANGE, AND SECTION
IP(6) = UTM COORDINATES
IP(7) = CENTROID NUMBER
IP(8) = STRAIGHT LINE DISTANCE FROM TOWNSHIP CENTER TO ROAD
IP(9) = DISTANCE ON ROAD TO TOWNSHIP CENTROID
IP(10) = GROUND LAND USE
IP(11) = USFS OWNERSHIP CODE
IP(12) = NATIONAL FOREST
* IP(13) = SITE INDEX
* IP(14) = PHYSIOGRAPHIC CLASS
* IP(15) = AGE
* IP(16) = USFS COVERTYPE CODE
* IP(17) = STAND SIZE AND DENSITY CLASS
* IP(18) = ASPECT, POSITION, AND SLOPE
* IP(19) = STAND AREA
* IP(20) = DISTANCE TO WATER
* IP(21) = DISTANCE TO ROAD
* IP(22) = PLOT EXPANSION FACTOR (ACREAGE)

* IPCOV I VAR USFS COVERTYPE CLASS
* IPOUN I VAR USFS OWNERSHIP CLASS
* ISUBCOV I VAR NUMBER OF SUBCLASSES WITHIN THE USER-DEFINED COVERTYPE CLASS
* ISUBOUN I VAR NUMBER OF SUBCLASSES WITHIN THE USER-DEFINED OWNERSHIP CLASS
* ISUP I VAR CORD AND BOLT VOLUME FOR PLOTTING PURPOSES
* ISUPSP I VAR SPECIES TYPE INVOLVED IN THE PLOTTING OPERATION
* J I VAR AN ORDERED OWNERSHIP CLASS, FROM 1 TO IOUN
* JCOMP I VAR AN ORDERED SPECIES COMPONENT WITHIN AN AGGREGATE SPECIES CLASS
* K I VAR AN ORDERED COVERTYPE CLASS, FROM 1 TO ICOV
* L I VAR AN ORDERED SPECIES TYPE WITHIN THE ANALYSIS PAIR
* LET I VAR RECODED VALUE FOR LETTER IN INTEGER FORMAT
* LETTER I VAR DECODED VALUE FOR RANGE DIRECTION FROM IP(5)
* M I VAR AN ORDERED PRODUCT TYPE WITHIN THE ARRAY PROD, FROM 8 TO 11
* MAXAGE I VAR UPPER BOUND FOR THE AGE CLASS WINDOW
* MINAGE I VAR LOWER BOUND FOR THE AGE CLASS WINDOW
* N I VAR INCREMENT IN THE COVERTYPE QUALIFIER TEST
* NBID I VAR NUMBER OF MARKETS IN THE DISTANCE MATRIX
* NSUBCOV I VAR AN ORDERED COVERTYPE SUBCLASS, FROM 1 TO ISUBCOV
* NSUBOUN I VAR AN ORDERED OWNERSHIP SUBCLASS, FROM 1 TO ISUBOUN
* QUENCH1 I VAR AN INDICATOR FLAG IN SUBROUTINE AGGOUN IF
OWNER IS NOT AGGREGATED

QUNCHK2 I VAR
AN INDICATOR FLAG IN SUBROUTINE BEFUN IF THE
PLOT DOES NOT AGREE WITH THE QUNCOMB(NSUBOWN)
SUBCLASS

QUNCOMB I ARRAY
CODES FOR EACH OF ISUBOWN OWNERSHIP
SUBCLASSES

QUNSPEC I ARRAY
CODES FOR EACH OF IOWN OWNERSHIP CLASSES

OWNER I VAR
THE REASSIGNED SCREEN OWNERSHIP CLASS

P I VAR
AN ORDERED MARKET IN THE COST CALCULATIONS,
FROM 1 TO NBID

PLOTID I VAR
A UNIQUE PLOT IDENTIFIER (BETWEEN INVENTORY
UNITS)

PLOTOPT I VAR
OPTION INDICATING WHETHER PLOTTING WILL BE
PERFORMED EXTERNALLY

PROD R ARRAY
SPECIES:PRODUCT INFORMATION READ FROM THE
PLOT SUMMARY MASTERFILE:

PROD(SPPSPEC,1) = NUMBER OF ALL TREES PER ACRE
PROD(SPPSPEC,2) = NUMBER OF TREES PER ACRE < 5 IN. DBH
PROD(SPPSPEC,3) = NUMBER OF TREES PER ACRE BETWEEN 5 AND
12 IN. DBH
PROD(SPPSPEC,4) = NUMBER OF TREES PER ACRE > 12 IN. DBH
PROD(SPPSPEC,5) = BASAL AREA PER ACRE OF ALL TREES
PROD(SPPSPEC,6) = BASAL AREA PER ACRE OF TREES > 5 IN. DBH
PROD(SPPSPEC,7) = BIOMASS (DRY-TONS PER ACRE)
PROD(SPPSPEC,8) = HARVESTABLE BIOMASS (DRY-TONS PER ACRE)
PROD(SPPSPEC,9) = SAWDOLT VOLUME (CORDS PER ACRE)
PROD(SPPSPEC,10) = PULPWOOD VOLUME (CORDS PER ACRE)
PROD(SPPSPEC,11) = SAWLOG VOLUME (CORDS PER ACRE)

R I VAR
INCREMENT IN THE OWNERSHIP QUALIFIER TEST

RANGE I VAR
DECODED VALUE FOR RANGE FROM IP(5)

SECT I VAR
DECODED VALUE FOR SECTION FROM IP(5)

SPPSPEC I ARRAY
ONE OF TWO SPECIES TYPE SPECIFICATIONS

SPPTYPE I ARRAY
A SPECIES AGGREGATION TYPE, FROM 1 TO 20 IN
THE USFS COMPOSITION LISTING

TCOST R ARRAY
TOTAL COST PER CORD (HARVCST + TRANCST)

TRANCST R ARRAY
TRANSPORT COST PER CORD TO A SPECIFIC MARKET
(50,000 LB. PAYLOAD TRUCK)
TOWN  I VAR  DECODED VALUE FOR TOWNSHIP FROM IP(5)  *
UNIT  I VAR  INVENTORY UNIT (SEPARATE NAT'L FORESTS)  *
WA   I VAR  WORD-ADDRESSABLE INPUT FOR DISTANCE MATRIX  *
RFTI  I ARRAY  WORD-ADDRESSABLE FILE INFORMATION TABLE  *
XNTA7 R VAR  TOTAL NUMBER OF TREES PER ACRE BETWEEN 5 AND
          12 IN. DBH  *
XNTA12 R VAR  TOTAL NUMBER OF TREES PER ACRE > 12 IN. DBH  *

******************************************************************************

VARIABLE AND DATA DECLARATION  BLOCK 100

INTEGER  ACRES,AGE,COVCHK1,COVCHK2,COVTYPE,ICOV,ICNTY,
  IOWN,ISUBCOV,ISUBOWN,ISUP,ISUPSP,J,
  JCOHP,K,L,LET,M,HAXAGE,MINAGE,N,NBID,NSUBCOV,
  NSUBOWN,QUNCHK1,QUNCHK2,OWNER,P,PLOTID,PLOPTOPT,R,
  RANGE,SECT,SPPTYPE,TOWN,UNIT,WA
INTEGER  C(42,4), CONTAB(28,3), COVCOMB(5), COVSPEC(14),
  DISTID(10), IP(22), IPCOV(94), IPOWN(96), IU1(5),
  IU2(12), IU3(28), IU4(42), QUNCOMB(5), QUNSPEC(13),
  SPSPSPEC(2), WAFTI(35)
REAL  BAA5X, CPA, DIST, HARVCST, XNTA7, XNTA12
REAL  PROD(31,11), TCOST(10), TRANCST(10)

EQUIVALENCE  (C(1,1), IU1(1))
EQUIVALENCE  (C(1,2), IU2(1))
EQUIVALENCE  (C(1,3), IU3(1))
EQUIVALENCE  (C(1,4), IU4(1))
EQUIVALENCE  (IP(9), DIST)

COMMON /A/ ISUBOWN, J, NSUBOWN, QUNCHK1, QUNCHK2, QUNCOMB,
  OWNER, QUNSPEC
COMMON /B/ COVCHK1, COVCHK2, COVCOMB, COVSPEC, COVTYPE,
  ISUBCOV, NSUBCOV

DATA  ((CONTAB(SPPTYPE,JCOHP), SPPTYPE=1,28), JCOHP=1,3) /28,1,1,
  2, 3, 4, 4, 6, 5, 7, 8, 9, 29, 0, 11, 12, 13, 18, 15, 16, 17, 20, 21,
  23, 24, 24, 25, 0, 2, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
  0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
DATA IPOCV /4,3,0,0,0,0,0,0,0,0,0,0,0,0,0,7,9,11,10,8,0,0,0,0,0,0,0,0,0,
2 0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,22,
3 0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,20,0,0,0,
4 0,0,0,0,23,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,17,21,0,18/:
DATA IPOWN /0,0,0,0,0,0,0,0,0,3,4,5,6,7,8,0,0,0,0,0,0,0,15,15,15,15,
2 15,15,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,18,18,18,18,18,
3 0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,16,16,16,16,
4 0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,12,12,12,12,12,
5 0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,13,13,13,13,13/,:
DATA IU1 /9,16,36,38,69/:
DATA IU2 /1,3,4,11,15,18,29,31,39,44,68,80/:
DATA IU3 /2,5,10,13,19,21,23,25,27,28,30,33,40,48,49,
2 55,56,58,62,66,70,71,73,77,79,82,83,85,86/:
DATA IU4 /6,7,8,12,14,17,20,22,24,26,32,34,35,37,41,42,
2 43,45,46,47,50,51,52,53,54,55,57,59,60,61,63,
3 64,65,67,72,74,75,76,78,81,83,84,87/:
DATA NBID /10/:
IF ((OWNSPEC(J) .EQ. 9) .OR. (OWNSPEC(J) .EQ. 19)) THEN
READ (1,*) ISUBOUN
READ (1,*) (OWNCOMB(NSUBOUN), NSUBOUN=1,ISUBOUN)
ENDIF
220 CONTINUE

*** READ THE SCREEN CODE FOR EACH ANALYSIS COVERTYPE CLASS. ***
*
READ (1,*) (COVSPEC(K), K=1,ICOV)
*
*** IF USER SPECIFIED A USER-DEFINED CLASS, READ THE NUMBER ***
* OF SUBCLASSES AND THEIR RESPECTIVE SCREEN CODES. *
*
DO 240 K=1,ICOV
IF ((COVSPEC(K) .EQ. 14) .OR. (COVSPEC(K) .EQ. 24)) THEN
READ (1,*) ISUBCOV
READ (1,*) (COVCOMB(NSUBCOV), NSUBCOV=1,ISUBCOV)
ENDIF
240 CONTINUE

*** READ THE CODES FOR THE TWO SPECIES TYPES TO BE ANALYZED. ***
*
READ (1,*) (SPSPEC(L), L=1,2)
*
*** SPECIFY WHETHER PLOTTING WILL BE PERFORMED: 1 = YES ***
* 2 = NO *
*
IF YES, READ THE CODE FOR THE SPECIES TYPE INVOLVED *
*
READ (1,*) PLOTOPT
IF (PLOTOPT .EQ. 1) THEN
READ (1,*) ISUPSPP
ENDIF
*
*** OPEN THE WORD-ADDRESSABLE RANDOM ACCESS FILE. ***
* READ A PLOT RECORD FROM THE PLOT SUMMARY MASTERFILE. *
*
CALL FILEUA (WAFIT,3LLFN,7LDISTMA1,2LRT,1LF,2LFL,(NBID*10))
CALL OPENH (WAFIT,5LINPUT)
260 READ (3) IP, PROD
IF (EOF(3) .NE. 0.0) GO TO 860

**

******************************************************************************

**

AGE SCREEN  BLOCK 300

**

TEST IF PLOT BELONGS IN ANALYSIS BASED ON ITS AGE
WITH RESPECT TO THE USER-SPECIFIED AGE WINDOW.

AGE = IP(15)
ACRES = IP(22)
IF ((AGE LT. MINAGE) .OR. (AGE GT. MAXAGE)) GO TO 260

**

******************************************************************************

**

OWNERSHIP SCREEN  BLOCK 400

**

TEST IF PLOT OWNERSHIP QUALIFIES FOR ANALYSIS.
RECODE THE USFS OWNERSHIP CLASS (IP0UN) TO THE APPROPRIATE SCREEN OWNERSHIP CLASS (OWNER) ACCORDING TO THE FOLLOWING SCHEDULE:

<table>
<thead>
<tr>
<th>USFS SURVEY</th>
<th>CODE TYPE</th>
<th>SCREEN MODEL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CODE TYPE</td>
<td>USFS COMPOSITION</td>
</tr>
<tr>
<td>--------------</td>
<td>-----------</td>
<td>------------------</td>
</tr>
<tr>
<td>-- --</td>
<td>1 PUBLIC</td>
<td>11+12+14+15+16</td>
</tr>
<tr>
<td>-- --</td>
<td>2 FEDERAL</td>
<td>11+12+14</td>
</tr>
<tr>
<td>11 USFS</td>
<td>3 USFS</td>
<td>12</td>
</tr>
<tr>
<td>12 BLN</td>
<td>4 BLN</td>
<td>12</td>
</tr>
<tr>
<td>13 INDIAN</td>
<td>5 INDIAN</td>
<td>13</td>
</tr>
<tr>
<td>14 MISC.FED.</td>
<td>6 MISC.FED.</td>
<td>14</td>
</tr>
<tr>
<td>15 STATE</td>
<td>7 STATE</td>
<td>15</td>
</tr>
<tr>
<td>16 CNTY/HUN</td>
<td>8 CNTY/HUN</td>
<td>16</td>
</tr>
<tr>
<td>-- --</td>
<td>9 OTHER PUB. USER DEF: 11...16</td>
<td></td>
</tr>
<tr>
<td>-- --</td>
<td>10 PRIVATE</td>
<td>&gt;20</td>
</tr>
<tr>
<td>-- --</td>
<td>11 LEASED</td>
<td>50°S+80°S+90°S</td>
</tr>
<tr>
<td>81-86 CORP PRV-L</td>
<td>12 CORP PRV-L</td>
<td>80°S</td>
</tr>
<tr>
<td>91-96 IND. PRV-L</td>
<td>13 IND. PRV-L</td>
<td>90°S</td>
</tr>
<tr>
<td>51-56 FARM QUN-L</td>
<td>14 FARM QUN-L</td>
<td>50°S</td>
</tr>
</tbody>
</table>
THE USER SPECIFIES THE NUMBER OF OWNERSHIP CLASSES (i.e., 13) TO BE ANALYZED, AND THEIR RESPECTIVE SCREEN CODES. THE USER CAN OPTIONALLY IDENTIFY A USER-DEFINED OWNERSHIP CLASS BY THE NUMBER OF SUBCLASSES WITHIN THAT DEFINED CLASS, AND THEIR RESPECTIVE SCREEN CODES. NO ANALYSIS CLASS MAY BE A SUBSET OF A MORE AGGREGATIVE ANALYSIS CLASS, AS THE FINAL OWNERSHIP DESIGNATED TO AN EMERGING PLOT IS THE MOST AGGREGATIVE QUALIFIER OF THE SPECIFIED OWNERSHIPS. THE DESCENDING HIERARCHY OF OWNERSHIP AGGREGATION IS THE USER-DEFINED CLASS, AN AGGREGATE CLASS, AND A DISCRETE CLASS.

OWNCHK1 = 0
OWNCHK2 = 0
OWNER = IPOWN(IP(11))

*** ANALYZE EACH OWNERSHIP CLASS SPECIFIED FOR THE ANALYSIS. ***

DO 450 J = 1, IOWN

*** TEST IF USER SPECIFIED AN AGGREGATE CLASS. ***

IF (OWNSPEC(J) .EQ. 1) GO TO 430
IF (OWNSPEC(J) .EQ. 2) GO TO 430
IF (OWNSPEC(J) .EQ. 10) GO TO 430
IF (OWNSPEC(J) .EQ. 11) GO TO 430
IF (OWNSPEC(J) .EQ. 20) GO TO 430
GO TO 440

430 CALL AGGOWN
IF (OWNCHK1 .EQ. 1) GO TO 450

*** TEST IF USER SPECIFIED A USER-DEFINED CLASS. ***

*
440 IF (DUNSPEC(J) .EQ. 9) OR (DUNSPEC(J) .EQ. 19)) THEN
    CALL DEFOWN
    IF (DWNCHK2 .EQ. 1) GO TO 450
    GO TO 460
ENDIF
450 CONTINUE
***
TEST TO DETERMINE IF THE PLOT BELONGS IN THE ANALYSIS.
***

460 R = 0
470 IF (R .LT. IOUN) THEN
    R = R + 1
    IF (OWNER .NE. DUNSPEC(R)) GO TO 470
ELSE
    GO TO 260
ENDIF

******************************************************************************

**********
COVERTYPE SCREEN
**********

TEST IF PLOT COVERTYPE QUALIFIES FOR ANALYSIS.
RECODE THE USFS COVERTYPE CLASS (IPCOV) TO THE APPROPRIATE SCREEN COVERTYPE CLASS (COVTYP) ACCORDING TO THE FOLLOWING SCHEDULE:

<table>
<thead>
<tr>
<th>USFS SURVEY CODE</th>
<th>TYPE</th>
<th>SCREEN CODE</th>
<th>TYPE</th>
<th>USFS COMPOSITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>--</td>
<td>--</td>
<td>1</td>
<td>SOFTWOODS .IE. 35</td>
<td></td>
</tr>
<tr>
<td>--</td>
<td>--</td>
<td>2</td>
<td>PINE</td>
<td>1+2</td>
</tr>
<tr>
<td>2</td>
<td>RD,WH PINE</td>
<td>3</td>
<td>RD,WH PINE</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>JACK PINE</td>
<td>4</td>
<td>JACK PINE</td>
<td>1</td>
</tr>
<tr>
<td>--</td>
<td>--</td>
<td>5</td>
<td>SPRUCE-FIR</td>
<td>12+13+16</td>
</tr>
<tr>
<td>--</td>
<td>--</td>
<td>6</td>
<td>SPRUCE</td>
<td>12+16</td>
</tr>
<tr>
<td>12</td>
<td>BLK SPRUCE</td>
<td>7</td>
<td>BLK SPRUCE</td>
<td>12</td>
</tr>
<tr>
<td>16</td>
<td>WH SPRUCE</td>
<td>8</td>
<td>WH SPRUCE</td>
<td>16</td>
</tr>
<tr>
<td>13</td>
<td>BALSAM FIR</td>
<td>9</td>
<td>BALSAM FIR</td>
<td>13</td>
</tr>
<tr>
<td>15</td>
<td>TAMARACK</td>
<td>10</td>
<td>TAMARACK</td>
<td>15</td>
</tr>
</tbody>
</table>

COVCHK1 = 0
COVCHK2 = 0
COVTYP = IPCOV(IP(16))

*** ANALYZE EACH COVERTYPE CLASS SPECIFIED FOR THE ANALYSIS. ***

DO 550 K=1,ICOV

*** TEST IF USER SPECIFIED AN AGGREGATE CLASS. ***
* IF (COVSPEC(K) .LE. 13) THEN  *
  IF (COVSPEC(K) .EQ. 1) GO TO 530  *
  IF (COVSPEC(K) .EQ. 2) GO TO 530  *
  IF (COVSPEC(K) .EQ. 5) GO TO 530  *
  IF (COVSPEC(K) .EQ. 6) GO TO 530  *
  IF (COVSPEC(K) .EQ. 13) GO TO 530  *
ELSE  *
  IF (COVSPEC(K) .EQ. 15) GO TO 530  *
  IF (COVSPEC(K) .EQ. 16) GO TO 530  *
  IF (COVSPEC(K) .EQ. 19) GO TO 530  *
  IF (COVSPEC(K) .EQ. 25) GO TO 530  *
  IF (COVSPEC(K) .EQ. 26) GO TO 530  *
ENDIF  *
GO TO 540  *
530 CALL AGGCOV  *
  IF (COVCHK1 .EQ. 1) GO TO 550  *
* *** TEST IF USER SPECIFIED A USER-DEFINED CLASS. ***  *
* 540 IF ((COVSPEC(K) .EQ. 14) .OR. (COVSPEC(K) .EQ. 24)) THEN  *
    CALL DEFCOV  *
  IF (COVCHK2 .EQ. 1) GO TO 550  *
  GO TO 560  *
ENDIF  *
550 CONTINUE  *
* *** TEST TO DETERMINE IF THE PLOT BELONGS IN THE ANALYSIS. ***  *
* 560 N = 0  *
  570 IF (N .LT. ICOV) THEN  *
    N = N + 1  *
    IF (COVTYP .NE. COVSPEC(N)) GO TO 570  *
ELSE  *
  GO TO 260  *
ENDIF  *
  PLOTID = (IP(1) * 100000) + IP(4)  *
  IF (UNIT .GT. 4) PLOTID = PLOTID + 400000  *
**SPECIES/PRODUCT ASSIGNMENT**

**BLOCK 600**

ASSIGN THE USFS DISCRETE SPECIES TYPES TO THE SCREEN
DISCRETE OR AGGREGATE SPECIES CODES (SPPSPEC), ACCORDING
TO THE SCHEDULE BELOW. CONVERT ROUNDWOOD AND BIOMASS
VOLUMES TO PROPER UNITS.

<table>
<thead>
<tr>
<th>SCREEN CODE</th>
<th>LABEL</th>
<th>USFS COMPOSITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SOFTWOODS</td>
<td>28</td>
</tr>
<tr>
<td>2</td>
<td>PINE</td>
<td>1 + 2 + 3</td>
</tr>
<tr>
<td>3</td>
<td>JACK PINE</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>RED PINE</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>WHITE PINE</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>SPRUCE-FIR</td>
<td>4 + 5 + 6</td>
</tr>
<tr>
<td>7</td>
<td>SPRUCE</td>
<td>4 + 6</td>
</tr>
<tr>
<td>8</td>
<td>WH SPRUCE</td>
<td>4</td>
</tr>
<tr>
<td>9</td>
<td>BLK SPRUCE</td>
<td>6</td>
</tr>
<tr>
<td>10</td>
<td>BALSAK FIR</td>
<td>5</td>
</tr>
<tr>
<td>11</td>
<td>TAMARACK</td>
<td>7</td>
</tr>
<tr>
<td>12</td>
<td>N WH CEDAR</td>
<td>8</td>
</tr>
<tr>
<td>13</td>
<td>HEMLOCK</td>
<td>9</td>
</tr>
<tr>
<td>14</td>
<td>HARDWOODS</td>
<td>29</td>
</tr>
<tr>
<td>15</td>
<td>NONASP HUD</td>
<td>29 - (24 + 25)</td>
</tr>
<tr>
<td>16</td>
<td>ASH</td>
<td>11 + 19</td>
</tr>
<tr>
<td>17</td>
<td>COTTONWOOD</td>
<td>12</td>
</tr>
<tr>
<td>18</td>
<td>SOFT MAPLE</td>
<td>13 + 14</td>
</tr>
<tr>
<td>19</td>
<td>HARD MAPLE</td>
<td>18</td>
</tr>
<tr>
<td>20</td>
<td>ELM</td>
<td>15</td>
</tr>
<tr>
<td>21</td>
<td>BIRCH</td>
<td>16 + 26</td>
</tr>
<tr>
<td>22</td>
<td>BASSWOOD</td>
<td>17</td>
</tr>
<tr>
<td>23</td>
<td>WHITE OAK</td>
<td>20</td>
</tr>
<tr>
<td>24</td>
<td>RED OAK</td>
<td>21 + 22</td>
</tr>
<tr>
<td>25</td>
<td>HICKORY</td>
<td>23</td>
</tr>
<tr>
<td>26</td>
<td>ASPEN</td>
<td>24 + 25</td>
</tr>
<tr>
<td>27</td>
<td>BIGTH ASP.</td>
<td>24</td>
</tr>
<tr>
<td>28</td>
<td>QUAK ASPEN</td>
<td>25</td>
</tr>
</tbody>
</table>
* DO 660 L=1,2
  DO 610 M=1,11
    PROD(SPPSPEC(L),M) = 0.0
  610 CONTINUE
  IF (SPPSPEC(L) .EQ. 15) THEN
    DO 620 M=1,11
      PROD(15,M) = PROD(29,M) - (PROD(24,M) + PROD(25,M))
    620 CONTINUE
  ELSE
    JCOMP = 1
    IF (CONTAB(SPPSPEC(L),JCOMP) .NE. 0) THEN
      DO 640 M=1,11
        PROD(SPPSPEC(L),M) = PROD(SPPSPEC(L),M) +
        PROD(CONTAB(SPPSPEC(L),JCOMP),M)
      640 CONTINUE
      IF (JCOMP .LT. 3) THEN
        JCOMP = JCOMP + 1
        GO TO 630
      ENDIF
    ENDIF
  ENDIF
  660 CONTINUE

*** CONVERT THE ROUNDBOARD AND BIOHAAS VOLUMES TO PROPER UNITS. ***

* DO 680 L=1,2
  PROD(SPPSPEC(L),B) = PROD(SPPSPEC(L),B)/2000.
  DO 670 M=9,11
    PROD(SPPSPEC(L),M) = PROD(SPPSPEC(L),M)/79.
  670 CONTINUE
  680 CONTINUE

**********************************************************************

************
HARVEST AND TRANSPORT COST CALCULATION BLOCK 700
************

* ORGANIZE THE NECESSARY PLOT CHARACTERISTICS IN ORDER TO
* CALCULATE THE ESTIMATED COST TO HARVEST AND TRANSPORT A
UNIT OF WOOD ON THE PLOT TO EACH OF THE MARKET CENTERS.
DECODE TOWNSHIP, RANGE, AND SECTION INFORMATION.

*** ORGANIZE THE PLOT CHARACTERISTICS ***

BAA5X = PROD(28,6) + PROD(29,6)
IF (BAA5X .EQ. 0.0) BAA5X = .01
XNTA7 = PROD(28,3) + PROD(29,3)
XNTA12 = PROD(28,4) + PROD(29,4)
CPA = (PROD(28,9) + PROD(29,9) + PROD(28,10) + PROD(29,10) +
2 * PROD(28,11) + PROD(29,11))/79.
IF (CPA .EQ. 0.0) CPA = .01
ISUP = (PROD(ISUPSPP,10) + PROD(ISUPSPP,9)) * FLOAT(ACRES)

*** CALCULATE HARVESTING COST ***

HARVCST = 24.1172 + .96595*((XNTA7+XNTA12)/BAA5X) +
2 * (10.753/CPA) + 3.9068*((XNTA7+XNTA12)/BAA5X)/CPA

*** CALCULATE TRANSPORTATION COST ***

DO 740 P=1,NBID
   DISTBID(P) = 0
740 CONTINUE

WA = (IP(7) - 1) * NBID + 1
CALL GET (WAFIT, DISTBID, WA)

DO 760 P=1,NBID
   DISTBID(P) = DISTBID(P) + DIST
   IF (DISTBID(P) .GE. 37) THEN
      TRANCST(P) = 1.1632569 + .11201575 * DISTBID(P)
   ELSE
      TRANCST(P) = 4.218775 + .0304175 * DISTBID(P)
   ENDIF
   TCOST(P) = TRANCST(P) + HARVCST
760 CONTINUE
*** DECODE TOWNSHIP, RANGE, AND SECTION INFORMATION ***
*
DECODE (10,780,IP(5)) TOWN, RANGE, LETTER, SECT
780 FORMAT (I3,1X,I3,A1,A12)
LET = 1
IF (LETTER .EQ. "U") LET = 2
ICHNTY = C(IP(2),IP(1))
*

******************************************************************************

********* OUTPUT BLOCK *********

*********** WRITE THE OPTIONAL OUTPUT FILE FOR THE PLOTTING ROUTINE ***********
*
IF (PLOTOPT .EQ. 1) THEN
  WRITE (8) PLOTID, ISUP, TCOST, ACRES
ENDIF

*********** WRITE THE OUTPUT FILE FOR SUPPLY ANALYSIS PROGRAMS ***********
*
WRITE (7) PLOTID, ICHNTY, TOWN, RANGE, LET, SECT,
  IP(I),I=7,9), OWNER, CVTYP, AOE, ACRES, ISUP,
  PROD(SPPSPEC(1),10), PROD(SPPSPEC(2),10), PROD(SPPSPEC(1),9),
  PROD(SPPSPEC(2),9), PROD(SPPSPEC(1),11), PROD(SPPSPEC(2),11),
  PROD(SPPSPEC(1),10), PROD(SPPSPEC(2),10), HARVCAST, DISTBID,
  TRANCAST
 *
80 TO 260
260 CALL CLOSEM (UAFIT)
STOP
END
END OF MAIN PROGRAM

SUBROUTINE AGGOWN

SUBPROGRAM IDENTIFICATION

AGGOWN ASSIGNs A PLOT's DISCRETE OWNERSHIP CLASS TO THE
MOST AGGREGATIVE QUALIFYING USER-SPECIFIED OWNERSHIP CLASS.

VARIABLE IDENTIFICATION

OUNSPEC = THE USER-SPECIFIED OWNERSHIP ANALYSIS CLASS
OWNER = THE RECODED QUALIFYING AGGREGATE OWNERSHIP CLASS
OUNCHK1 = AN INDICATOR FLAG IF OWNER IS NOT AGGREGATED

VARIABLE DECLARATION

INTEGER J, OUNCHK1, OWNER
INTEGER OUNCOMB(5), OUNSPEC(I3)
COMMON /A/ ISUBQUN, J, MSUBQUN, OUNCHK1, OUNCHK2, OUNCOMB,
2 OWNER, OUNSPEC

EXECUTION BLOCK

OUNCHK1 = 0
IF ((OUNSPEC(J) .EQ. 1) .OR. (OUNSPEC(J) .EQ. 2)) THEN
  IF (OUNSPEC(J) .EQ. 1) THEN
    IF ((OWNER .LE. 8) .AND. (OWNER .NE. 5)) GO TO 50
    GO TO 30
  ELSE
    IF ((OWNER .LE. 6) .AND. (OWNER .NE. 5)) GO TO 50
    GO TO 30
  ENDFIF
ELSEIF (OUNSPEC(J) .NE. 20) THEN
IF (OWNSPEC(J) .EQ. 10) THEN
   IF (((OWNER .GE. 12) .AND. (OWNER .LE. 18)) GO TO 50
   GO TO 30
ELSE
   IF (((OWNER .GE. 12) .AND. (OWNER .LE. 14)) GO TO 50
   GO TO 30
ENDIF
ELSE
   GO TO 50
ENDIF
30 OWNCHK1 = 1
   GO TO 70
50 OWNER = OWNSPEC(J)
70 RETURN
END
SUBROUTINE DEFOUN

SUBPROGRAM IDENTIFICATION

DEFOUN assigns a plot's discrete ownership class to the qualifying user-defined ownership analysis class.

VARIABLE DEFINITION

OUNSPEC = the user-specified ownership analysis class
ISUBOUN = the number of subclasses identified within the user-defined ownership class
NSUBOUN = an ordered subclass, from 1 to ISUBOUN
OWNCOMB = a unique user-specified ownership subclass
OWNCHK2 = an indicator flag if the plot does not agree with the OWNCOMB(NSUBOUN) subclass
OWNER = the reassigned ownership classification

VARIABLE DECLARATION

INTEGER ISUBOUN, J, JJ, NSUBOUN, OUNCHK2, OWNER
INTEGER OWNCOMB(5), OUNSPEC(13)
COMMON /A/ ISUBOUN, J, NSUBOUN, OUNCHK1, OUNCHK2, OWNCOMB,
2 OWNER, OUNSPEC

EXECUTION BLOCK

OUNCHK2 = 0
IF (OUNSPEC(J) .EQ. 9) THEN
  NSUBOUN = 0
30 IF (NSUBOUN .LT. ISUBOUN) THEN

END OF SUBPROGRAM
DO 35 JJ=3,8
    IF ((OWNCOMB(NSUBOUN) .EQ. JJ) .AND.
    (OWNER .EQ. JJ)) GO TO 40
35    CONTINUE
    GO TO 30
ENDIF
OWNCHK2 = 1
RETURN
40    OWNER = 9
ELSE
    NSUBOUN = 0
60    IF (NSUBOUN .LT. ISUBOUN) THEN
        NSUBOUN = NSUBOUN + 1
        DO 65 JJ=12,19
            IF ((OWNCOMB(NSUBOUN) .EQ. JJ) .AND.
            (OWNER .EQ. JJ)) GO TO 70
65        CONTINUE
            GO TO 60
ENDIF
OWNCHK2 = 1
GO TO 80
70    OWNER = 19
80    ENDIF
RETURN
END
**SUBROUTINE AGGCOV**

**SUBPROGRAM IDENTIFICATION**

AGGCOV assigns a plot's discrete covertype class to the most aggregative qualifying user-specified covertype class.

**VARIABLE IDENTIFICATION**

COVSPEC = the user-specified covertype analysis class
COVTYPE = the recoded qualifying aggregate covertype class
COVCHK1 = an indicator flag if COVTYPE is not aggregated

**VARIABLE DECLARATION**

INTEGER COVCHK1,COVTYPE,K
INTEGER COVCBH(5), COVSPEC(14)
COMMON /B/ COVCHK1,COVCHK2,COVCBH,COVSPEC,COVTYPE,
2 ISUBCOV,K,NSUBCOV

**EXECUTION BLOCK**

COVCHK1 = 0
IF (COVSPEC(K) .LE. 13) THEN
  IF (COVSPEC(K) .EQ. 1) THEN
    IF (COVTYPE .LT. 12) GO TO 50
    GO TO 30
  ELSEIF (COVSPEC(K) .EQ. 2) THEN
    IF (COVTYPE .LE. 4) GO TO 50
    GO TO 30
  ELSEIF (COVSPEC(K) .EQ. 5) THEN
    IF ((COVTYPE .GE. 7) .AND. (COVTYPE .LE. 9)) GO TO 50

END OF SUBPROGRAM
GO TO 30
ELSEIF (COVSPEC(K) .EQ. 6) THEN
    IF ((COVTYP .EQ. 7) .OR. (COVTYP .EQ. 8)) GO TO 50
    GO TO 30
ELSE
    IF ((COVTYP .EQ. 7) .OR. ((COVTYP .GE. 10) .AND. 
      2
      (COVTYP .LE. 12))) GO TO 50
    GO TO 30
ENDIF
ELSEIF (COVSPEC(K) .LT. 26) THEN
    IF (COVSPEC(K) .EQ. 15) THEN
        IF (COVTYP .GT. 15) GO TO 50
        GO TO 30
    ELSEIF (COVSPEC(K) .EQ. 16) THEN
        IF ((COVTYP .EQ. 17) .OR. (COVTYP .EQ. 18)) GO TO 50
        GO TO 30
    ELSEIF (COVSPEC(K) .EQ. 19) THEN
        IF ((COVTYP .EQ. 18) .OR. (COVTYP .EQ. 20)) GO TO 50
        GO TO 30
    ELSE
        IF ((COVTYP .EQ. 7) .OR. (COVTYP .EQ. 10) .OR. 
      2
      (COVTYP .EQ. 11) .OR. (COVTYP .EQ. 20)) GO TO 50
        GO TO 30
    ENDIF
ELSE
    GO TO 50
ENDIF
30 COVCJK1 = .1
    GO TO 70
50 COVTYP = COVSPEC(K)
    GO TO 70
    RETURN
END
END OF SUBPROGRAM

SUBROUTINE DEFCOV

SUBPROGRAM IDENTIFICATION

DEFCOV ASSIGNS A PLOT'S DISCRETE COVERTYPE CLASS TO THE
QUALIFYING USER-DEFINED COVERTYPE ANALYSIS CLASS.

VARIABLE DEFINITION

COVSPEC = THE USER-SPECIFIED COVERTYPE ANALYSIS CLASS
ISUBCOV = THE NUMBER OF SUBCLASSES IDENTIFIED WITHIN
        THE USER-DEFINED COVERTYPE CLASS
NSUBCOV = AN ORDERED SUBCLASS, FROM 1 TO ISUBCOV
COVCOMB = A UNIQUE USER-SPECIFIED COVERTYPE SUBCLASS
COVCHK2 = AN INDICATOR FLAG IF THE PLOT DOES NOT AGREE
          WITH THE COVCOMB(NSUBCOV) SUBCLASS
COVTYP = THE REASSIGNED COVERTYPE CLASSIFICATION

VARIABLE DECLARATION

INTEGER COVCHK2, COVTYP, ISUBCOV, K, KK, NSUBCOV
INTEGER COVCOMB(5), COVSPEC(14)
COMMON /B/ COVCHK1, COVCHK2, COVCOMB, COVSPEC, COVTYP,
2 ISUBCOV, K, NSUBCOV

EXECUTION BLOCK

COVCHK2 = 0
IF (COVSPEC(K) .EQ. 14) THEN.
   NSUBCOV = 0
30 IF (NSUBCOV .LT. ISUBCOV) THEN
   NSUBCOV = NSUBCOV + 1
IF (COVCOMB(NSUBCOV).EQ.3).AND. (COVTYP.EQ.3)) GO TO 40
IF (COVCOMB(NSUBCOV).EQ.4).AND. (COVTYP.EQ.4)) GO TO 40
DO 35 KK=7,12
   IF (COVCOMB(NSUBCOV).EQ. KK).AND. (COVTYP.EQ. KK)) GO TO 40
  2 CONTINUE
  GO TO 30
ENDIF
COVCHK2 = 1
RETURN
40 COVTYP = 14
ELSE
   NSUBCOV = 0
60 IF (NSUBCOV.LT. ISCUBCOV) THEN
      NSUBCOV = NSUBCOV + 1
      IF (COVCOMB(NSUBCOV).EQ.17).AND. (COVTYP.EQ.17)) GO TO 70
      IF (COVCOMB(NSUBCOV).EQ.18).AND. (COVTYP.EQ.18)) GO TO 70
      DO 65 KK=20,23
         IF (COVCOMB(NSUBCOV).EQ. KK).AND. (COVTYP.EQ. KK)) GO TO 70
     2 CONTINUE
     GO TO 60
   ENDIF
   COVCHK2 = 1
   GO TO 80
70 COVTYP = 24
80 ENDIF
RETURN
END
APPENDIX C:

Source Code Listing of Second Computer Program
PROGRAM PROVE (INPUT, OUTPUT, TAPE3, TAPE6, TAPE8)

*********

PROGRAM IDENTIFICATION

*********

THIS PROGRAM CREATES TIMBER SUPPLY SCHEDULES FOR A MAXIMUM
OF 10 MARKET CENTERS. IT IS CAPABLE OF ANALYZING UP TO 16
OWNERSHIP/OVERTYPE COMBINATIONS (IE: 4 COVERTYPES WITHIN
EACH OF 4 OWNERSHIP CLASSES, 8 COVERTYPES WITHIN EACH OF 2
OWNERSHIP CLASSES, ETC.) FOR A SINGLE SPECIFIED AGE WINDOW
CLASS. HARVESTABLE VOLUMES WITHIN EACH OF 4 PRODUCT
CLASSES ARE TABULATED FOR EACH OF 2 SPECIES TYPES ACROSS
VARIABLE DISTANCE OR TRANSPORTATION COST ZONES. INPUT IS A
PARAMETER LIST AND FILE TAPE3 CREATED BY PROGRAM SCREEN.
THE OUTPUT FILES ARE TAPE6 AND TAPE8, WITH DISCRETE TABLES
ON FILE TAPE6 AND CUMULATIVE TABLES ON FILE TAPE8.

*****

VARIABLE DEFINITION

*****

ACRES = EXPANDED ACREAGE OF AN INVENTORY PLOT (NOT USED)
AGE = AGE OF AN INVENTORY PLOT
CCOSEN = TRAILING END OF THE CUMCOST LABELS
CENT = CENTROID LOCATION OF AN INVENTORY PLOT (NOT USED)
COSCLAS = WIDTH OF EACH COST CLASS
COSTNH = LABELS FOR EACH DISCRETE COST ZONE
COSTYP = RELATIVE UNIT OF COMPARISON FOR A COST CLASS
COV = UNIQUE OVERTYPE CLASS
COVTYP = OVERTYPE CLASS OF AN INVENTORY PLOT
CTNH = LABELS FOR EACH OVERTYPE CLASS
CUMCOST = LABELS FOR EACH CUMULATIVE COST ZONE
CUMDIST = LABELS FOR EACH CUMULATIVE DISTANCE ZONE
CUMTAB = VOLUME OF A SPECIES:PRODUCT TYPE IN A CUMULATIVE
DISTANCE/COST CLASS WITHIN A TABLE COMPARISON TYPE
DCOSEN = TRAILING END OF THE COSTNH LABELS
DISCLAS = WIDTH OF EACH DISTANCE CLASS
DIST = DISTANCE TO A MARKET FROM AN INVENTORY PLOT
DISTAB = VOLUME OF A SPECIES:PRODUCT TYPE IN A DISCRETE
DIST/COST CLASS WITHIN A TABLE COMPARISON TYPE
DISTNH = LABELS FOR EACH DISCRETE DISTANCE ZONE
DISTYP = RELATIVE UNIT OF COMPARISON FOR A DISTANCE CLASS
* HARVCST = HARVESTING COST PER CORD FOR AN INVENTORY PLOT
* HIGHAGE = AGE WINDOW UPPER BOUND FOR ALL TABLE COMPARISON TYPES
* ICNTY = COUNTY OF AN INVENTORY PLOT (NOT USED)
* ICOST = NUMBER OF RESTRUCTURED ANALYSIS COST ZONES
* ICOV = NUMBER OF COVERTYPE CLASSES
* IDIST = NUMBER OF RESTRUCTURED ANALYSIS DISTANCE ZONES
* IMKRT = UNIQUE MARKET
* IMT = NUMBER OF MARKETS
* INDEX = TABLE AXIS FOR ANALYSIS DISTANCE/COST ZONES
* IOWN = NUMBER OF OWNERSHIP CLASSES
* IP = DISTANCES FROM PLOT TO ROAD AND ROAD TO CENTROID
* IPROD = NUMBER OF SPECIES*PRODUCT VOLUMES IN ARRAY VOL
* ISUP = PULPWOOD AND BOLT VOLUMES FOR PLOTTING PURPOSES
* ITAB = NUMBER OF TABLE COMPARISON TYPES (= IOWN * ICOV)
* L1 *
* L2 ** = LOGICAL VARIABLES FOR ASSIGNING EACH PLOT TO A *
* L3 ** TABLE COMPARISON TYPE *
* L4 *
* LET = RANGE DIRECTION (NOT USED)
* LOWAGE = AGE WINDOW LOWER BOUND FOR ALL TABLE COMPARISON TYPES
* MHTNAM = LABELS FOR EACH MARKET
* NTAB = UNIQUE TABLE COMPARISON TYPE
* OVN = UNIQUE OWNERSHIP CLASS
* OWNER = OWNERSHIP CLASS OF AN INVENTORY PLOT
* OWNAM = LABELS FOR EACH OWNERSHIP CLASS
* PLOTID = PLOT IDENTIFICATION NUMBER
* RANGE = RANGE OF AN INVENTORY PLOT (NOT USED)
* SECT = SECTION OF AN INVENTORY PLOT (NOT USED)
* SPEC1 = FIRST OF TWO SPECIES TYPES FOR ANALYSIS
* SPEC2 = SECOND OF TWO SPECIES TYPES FOR ANALYSIS
* SPECNAM = LABELS FOR EACH SPECIES TYPE
* TABOPT = TABLE INDEX OPTION (DISTANCE OF COST ZONES)
* TCOST = HARVEST COST + TRANSPORT COST PER CORD TO A MARKET
* TOWN = TOWNSHIP OF AN INVENTORY PLOT (NOT USED)
* TRANCS = TRANSPORTATION COST PER CORD TO A MARKET
* VOL = SELECTED VOLUMES PER ACRE OF AN INVENTORY PLOT
* 
***** VARIABLE DECLARATION *****
DATA DECLARATION

DATA MRKTNAM /'INT. FALLS', 'CLOQUET', 'GRAND RAP.', 'BEHINDJ',
1 'COOK', 'SARTELL', 'BIG FORK', 'VIRGINIA',
3 'ISABELLA', 'BRAINERD'/
DATA SPECNAM /'SOFTWOODS', 'PINE', 'JACK PINE',
2 'RED PINE', 'WHITE PINE', 'SPRUCE-FIR',
3 'SPRUCE', 'WH SPRUCE', 'BLK SPRUCE',
4 'BALSAM FIR', 'TAMARACK', 'N WH CEDAR',
5 'HEKLOCK', 'HARDWOODS', 'HOGASP HUB',
6 'ASH', 'COTTONWOOD', 'SOFT MAPLE',
7 'HARD MAPLE', 'ELM', 'BIRCH',
8 'BASSWOOD', 'WHITE OAK', 'RED OAK',
9 'HICKORY', 'ASBEN', 'BIG H ASB.',
1 'QUAK ASPEN'/
DATA QUNNAM /'PUBLIC', 'FEDERAL', 'USFS', 'BLM', 'INDIAN',
2 'MISC. FED.', 'STATE', 'CNTY/HUN',
3 'OTHER PUB.', 'PRIVATE', 'LEASED', 'CORP PRV-L',
4 'IND. PRV-L', 'FARM OWN-L', 'FOR. IND.',
5 'CORP. PRV.', 'IND. PRV.', 'FARM OWN.',
6 'OTHER PRV.', 'ALL'/
DATA CTHAH /'SOFTWOODS', 'PINE', 'RD WH PINE', 'JACK PINE',
2 'SPRUCE-FIR', 'SPRUCE', 'BLK SPRUCE', 'WH SPRUCE',
3 'BALSAM FIR', 'TAMARACK', 'N WH CEDAR',
4 'E RD CEDAR', 'SWAMP CON.', 'OTHER SOFT',
5 'HARDWOODS', 'POPULUS', 'ASBEN', 'BAL POPLAR',

IRMD(A) = IFIX(A + 0.5)

READ USER-DEFINED PARAMETER LIST

INPUT THE NUMBER OF MARKETS TO BE ANALYZED, AND THE NUMBER OF DUNESHIP, COVERTYPE, AND TABLE COMPARISON TYPE CLASSES.

READ *, INT, IOUN, ICOV, ITAB

INPUT CODES OF THE TWO SPECIES TYPES TO BE ANALYZED AND
* THE LOWER AND UPPER BOUNDS (IN YEARS) FOR THE AGE WINDOW TO *
* BE ANALYZED. FOR AN UPPER-BOUNDED CASE ONLY, USE LOWAGE = 0;*
* FOR A LOWER-BOUNDED CASE ONLY, USE HIGHAGE = 999.            *
* *
* READ *, SPEC1, SPEC2, LOWAGE, HIGHAGE                        *
* *** INPUT THE TABLE INDEX OPTION: 1 = DISTANCE CLASSES        ***
* 2 = TOTAL COST CLASSES                                        *
* *
* READ *, TABOPT                                                *
* *** INPUT THE CODES OF THE OWNERSHIP CLASSES AND COVERTYPE ***
* CLASSES FOR EACH OF THE TABLE COMPARISON TYPES 1,...,ITAB      *
* *
DO 10 I=1,ITAB
    READ *, OWN(I), COV(I)
10 CONTINUE
*
DO 400 IMRKT=1,INT
*
*** RESET THE TABLES TO ZERO FOR THE NEW MARKET ***
*
DO 50 N=1,IPROD
    DO 40 M=1,IDIST
        DO 30 HTAB=1,ITAB
            DISTAB(N,M,HTAB) = 0.0
            CNTTAB(N,M,HTAB) = 0.0
30 CONTINUE
40 CONTINUE
50 CONTINUE
REWIND 3
*
*** READ THE INPUT FILE (TAPE3) CREATED BY PROGRAM SCREEN ***
*
100 READ (3) PLOTID,ICHTY,TOWN,RANGE,LET,SECT,CEHT,IP,
    2 OWNER,COVTYP,AGE,ACRES,ISUP,VOL,HARVST,DIST,TRANSCST
    IF (EOF(3) .NE. 0.0) GO TO 400
*
*** CALCULATE THE TOTAL COST PER CORD FOR THE PLOT ***
DO 150 II=1,INT
  TCOST(II) = TRANCST(II) + HARVCST
150 CONTINUE

*** ASSIGN THE PLOT TO A UNIQUE DISCRETE TABLE ***
* COMPARISON TYPE (NTAB) *
*
I = 0
200 IF (I .LT. ITAB) THEN
   I = I+1
   L1 = OWNER .EQ. OWN(I)
   L2 = CQVTPY .EQ. COV(I)
   L3 = AGE .GE. LOUAGE
   L4 = AGE .LE. HIGHAGE
   IF (.NOT. (L1 .AND. L2 .AND. (L3 .AND. L4))) GO TO 200
   NTAB = 1
ELSE
   GO TO 100
ENDIF

*** ASSIGN THE PLOT TO A UNIQUE ANALYSIS ***
* DISTANCE OR COST ZONE (INDEX) *
*
IF (TABOPT .EQ. 1) THEN
   DISTTYP = DIST(IRMWT)/DISCLAS
   IF (DISTTYP .GT. 30) THEN
      INDEX = 14
   ELSEIF (DISTTYP .GT. 20) THEN
      INDEX = 13
   ELSEIF (DISTTYP .GT. 15) THEN
      INDEX = 12
   ELSEIF (DISTTYP .GT. 10) THEN
      INDEX = 11
   ELSEIF (DISTTYP .GT. 0) THEN
      INDEX = DISTTYP
   ELSE
      INDEX = 1
ENDIF
ELSE
   COSTTYP = (TCOST(IMRKT)*10.0)/COSCLAS
   IF (COSTTYP .GE. 300) THEN
      INDEX = 14
   ELSEIF (COSTTYP .GE. 275) THEN
      INDEX = 13
   ELSEIF (COSTTYP .GE. 250) THEN
      INDEX = 12
   ELSEIF (COSTTYP .GE. 150) THEN
      INDEX = (COSTTYP/10) - 13
   ELSE
      INDEX = 1
   ENDIF
ENDIF

***
   ADD THE VOLUMES TO THE TABLES
***

* DO 300 J=1,IPROD
   DISTAB(J,INDEX,NTAB) = DISTAB(J,INDEX,NTAB)
      + VOL(J)*FLOAT(ACRES)
300 CONTINUE

GO TO 100

***
   CREATE THE DISCRETE AND CUMULATIVE TABLES.
***
    WRITE THE DISCRETE TABLES TO OUTPUT FILE TAPEC.
    WRITE THE CUMULATIVE TABLES TO OUTPUT FILE TAPEB.
    IF SPECIFIED, GENERATE THE TABLES IN DISTANCE FORMAT
***

400 IF (TABOPT .EQ. 1) THEN
   DO 470 K=1,IOUN
      DO 460 L=1,ICOV
         NTAB = ICOV + (K-1) + L
         WRITE (6,410) HRKTNAM(IMRKT), QUNHAN(QUN(NTAB)),
                        CTNAM(COV(NTAB)), LOUAGH, HIGHAGE, SPECNAM(SPEC1),
                        SPECNAM(SPEC2), SPECNAM(SPEC1), SPECNAM(SPEC2),
                        SPECNAM(SPEC1), SPECNAM(SPEC2), SPECNAM(SPEC1),
                        SPECNAM(SPEC2)
         WRITE (8,410) HRKTNAM(IMRKT), QUNHAN(QUN(NTAB)),
                        CTNAM(COV(NTAB)), LOUAGH, HIGHAGE, SPECNAM(SPEC1),
                        SPECNAM(SPEC2), SPECNAM(SPEC1), SPECNAM(SPEC2),
                        SPECNAM(SPEC1), SPECNAM(SPEC2), SPECNAM(SPEC1),
                        SPECNAM(SPEC2)
CTNAM(COV(HTAB)), LOUAGE, HIGHAGE, SPECNAM(SPEC1),
SPECNAH(SPEC2), SPECNAM(SPEC1), SPECNAH(SPEC2),
SPECNAH(SPEC1), SPECNAM(SPEC2), SPECNAH(SPEC1),
SPECNAH(SPEC2)

 FORMAT (1H1, '/', 30X, 'MARKET: ', A10 / 30X,
 'OWNERSHIP: ', A10, 5X, 'COVERTYPE: ', A10, 5X,
 'AGE CLASS: ', I3, ',', I3 / 4X, 'DISTANCE', 10X,
 'PULPOOD VOLUME', 13X, 'BOLT VOLUME', 14X,
 'SAUDEL VOLUME', 11X, 'HARVESTABLE BIOMASS', / 6X,
 'ZONE', 16X, '(CUTS)', 2(19X, '(CUTS)'), 19X,
 '(DRI-TOHS)' / 16X, 4(2X, 2A( '<'-)'), / 5X, '(HILES)',
 4X, 4(3X, A10, 3X, A10) / 4X, 9( '<'-'), 3X, 8(2X, 11( '<'-'))

 DO 450 M=1,IDIST
   WRITE (4,420) DISTNAH(M), (IRHD(DISTAB(M,N,NTAB)),
   N=1,IPROD)

 420 FORMAT (14X, 'I', 107X, 'I' / 5X, A7, 'I', BI13, 'I')
   IF (M .EQ. 1) THEN
     DO 430 N=1,IPROD
       CUMTAB(M,N,NTAB) = DISTAB(M,N,NTAB)
      CONTINUE
     ELSE
     DO 440 N=1,IPROD
       CUMTAB(M,N,NTAB) = DISTAB(M,N,NTAB)
       + CUMTAB(M, (N-1), NTAB)
      CONTINUE
   ENDIF
      WRITE (8,420) CUHDIST(M), (IRHD(CUHTAB(M,N,NTAB)),
   N=1,IPROD)
   CONTINUE
   CONTINUE
   CONTINUE

 *** IF SPECIFIED, GENERATE THE TABLES IN COST FORMAT ***

 ELSE
   DO 570 K=1,10
    DO 560 L=1,ICOV
    NTAB = ICOV * (K-1) + L
    WRITE (6,510) MKTNAM(MRNKT), QUNNAM(QUN(NTAB)),
   CONTINUE
   CONTINUE

 *
CTNAH(COV(NTAB)), LOUAGE, HIGHAGE, SPECNAH(SPEC1),
SPECNAH(SPEC2), SPECNAH(SPEC1), SPECNAH(SPEC2),
SPECNAH(SPEC1), SPECNAH(SPEC2), SPECNAH(SPEC1),
SPECNAH(SPEC2)
WRITE (8,510) NRKTNAM(IHRRT), QUNNAH(QUN(NTAB)),
CTNAH(COV(NTAB)), LOUAGE, HIGHAGE, SPECNAH(SPEC1),
SPECNAH(SPEC2), SPECNAH(SPEC1), SPECNAH(SPEC2),
SPECNAH(SPEC1), SPECNAH(SPEC2), SPECNAH(SPEC1),
SPECNAH(SPEC2)

510 FORMAT (I1H ////////// 30X, 'MARKET:', A10 / 30X,
'OWNERSHIP:', A10, 5X, 'COVERTYPE:', A10, 5X,
'AGE CLASS:', I3, '-', I3 /// 1X, 'TOTAL COST', 10X,
'PULPOOD VOLUME', 13X, 'BOLT VOLUME', 14X,
'SAWLOG VOLUME', 11X, 'HARVESTABLE BIOMASS' / 4X,
'ZONE', 17X, '(COURS)', 2(19X, '(COURS)'), 19X,
'(DRY-TONS)' / 16X, 4(2X, 2A('')) / 2X, '(#/CORD)',
6X, 4(3X,A10,3X,A10) / 1X,11(''), 4X,8(2X,11(''))
DO 550 N=1,ICOST
WRITE (4,520) COSTNAH(H), DCOSEND(H),
2 (IRND (DISTAB(N,H,NTAB)), N=1,IPROD)
520 FORMAT (14X, ':', 107X, ':' / 1X, A6, A5, ':', ':
2 BI13, ':')
IF (H .EQ. 1) THEN
DO 530 N=1,IPROD
CUHTAB(N,H,NTAB) = DISTAB(N,H,NTAB)
530 CONTINUE
ELSE
DO 540 N=1,IPROD
CUHTAB(N,H,NTAB) = DISTAB(N,H,NTAB)
2 + CUHTAB(N,(H-1),NTAB)
540 CONTINUE
ENDIF
WRITE (8,520) CUMCOST(N), CCOSEND(N),
2 (IRND (CUHTAB(H,H,NTAB)), N=1,IPROD)
550 CONTINUE
560 CONTINUE
570 CONTINUE
ENDIF
*** REPEAT THE PROCEDURE FOR THE NEXT MARKET ***
*
600 CONTINUE
*
STOP
END
APPENDIX D:

Table Examples of Discrete Distance and Cost Classes
<table>
<thead>
<tr>
<th>DISTANCE ZONE</th>
<th>PULPUDD VOLUME (CORDS)</th>
<th>BOLT VOLUME (CORDS)</th>
<th>SAULUG VOLUME (CORDS)</th>
<th>HARVESTABLE BIOMASS (DRY-TONS)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ASPEN</td>
<td>NONASP HUD</td>
<td>ASPEN</td>
<td>NONASP HUD</td>
</tr>
<tr>
<td>&lt; 10</td>
<td>4360</td>
<td>0</td>
<td>11162</td>
<td>0</td>
</tr>
<tr>
<td>11 - 20</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>21 - 30</td>
<td>29676</td>
<td>66016</td>
<td>211876</td>
<td>74063</td>
</tr>
<tr>
<td>31 - 40</td>
<td>52445</td>
<td>11445</td>
<td>28549</td>
<td>21595</td>
</tr>
<tr>
<td>41 - 50</td>
<td>85989</td>
<td>21924</td>
<td>40902</td>
<td>13417</td>
</tr>
<tr>
<td>51 - 60</td>
<td>249673</td>
<td>19730</td>
<td>190329</td>
<td>30800</td>
</tr>
<tr>
<td>61 - 70</td>
<td>144189</td>
<td>36580</td>
<td>65649</td>
<td>40344</td>
</tr>
<tr>
<td>71 - 80</td>
<td>71778</td>
<td>20701</td>
<td>49689</td>
<td>16217</td>
</tr>
<tr>
<td>81 - 90</td>
<td>72444</td>
<td>16428</td>
<td>29989</td>
<td>24359</td>
</tr>
<tr>
<td>91 - 100</td>
<td>68743</td>
<td>10067</td>
<td>56074</td>
<td>12533</td>
</tr>
<tr>
<td>101 - 150</td>
<td>845079</td>
<td>160947</td>
<td>453618</td>
<td>192598</td>
</tr>
<tr>
<td>151 - 200</td>
<td>290319</td>
<td>53470</td>
<td>119172</td>
<td>66614</td>
</tr>
<tr>
<td>201 - 300</td>
<td>137010</td>
<td>35918</td>
<td>125880</td>
<td>42392</td>
</tr>
<tr>
<td>&gt; 300</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
### Appendix D: Table 2. Volume Distribution by Discrete Distance Classes

<table>
<thead>
<tr>
<th>Distance Zone (Miles)</th>
<th>Pulpwood Volume (Cords)</th>
<th>Bolt Volume (Cords)</th>
<th>Sawlog Volume (Cords)</th>
<th>Harvestable Biomass (Dry-Tons)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Aspen</td>
<td>NonASP_HUD</td>
<td>Aspen</td>
<td>NonASP_HUD</td>
</tr>
<tr>
<td>&lt; 10</td>
<td>19662</td>
<td>1039</td>
<td>17560</td>
<td>182</td>
</tr>
<tr>
<td>11 - 20</td>
<td>20250</td>
<td>7155</td>
<td>16815</td>
<td>9912</td>
</tr>
<tr>
<td>21 - 30</td>
<td>330319</td>
<td>80383</td>
<td>274889</td>
<td>119075</td>
</tr>
<tr>
<td>31 - 40</td>
<td>99991</td>
<td>17117</td>
<td>72807</td>
<td>35134</td>
</tr>
<tr>
<td>41 - 50</td>
<td>120590</td>
<td>49171</td>
<td>110561</td>
<td>69363</td>
</tr>
<tr>
<td>51 - 60</td>
<td>260322</td>
<td>36267</td>
<td>243724</td>
<td>62423</td>
</tr>
<tr>
<td>61 - 70</td>
<td>177287</td>
<td>69454</td>
<td>134666</td>
<td>97266</td>
</tr>
<tr>
<td>71 - 80</td>
<td>156767</td>
<td>28056</td>
<td>159631</td>
<td>52140</td>
</tr>
<tr>
<td>81 - 90</td>
<td>108319</td>
<td>47845</td>
<td>71446</td>
<td>80325</td>
</tr>
<tr>
<td>91 - 100</td>
<td>126825</td>
<td>33913</td>
<td>107364</td>
<td>51823</td>
</tr>
<tr>
<td>101 - 150</td>
<td>855857</td>
<td>212993</td>
<td>710995</td>
<td>309652</td>
</tr>
<tr>
<td>151 - 200</td>
<td>220261</td>
<td>83819</td>
<td>154247</td>
<td>149116</td>
</tr>
<tr>
<td>201 - 300</td>
<td>192924</td>
<td>65092</td>
<td>182479</td>
<td>99104</td>
</tr>
<tr>
<td>&gt; 300</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
## APPENDIX D: TABLE 3. VOLUME DISTRIBUTION BY DISCRETE DISTANCE CLASSES

**YEAR:** 2000  
**MARKET:** BEHIDJI  
**OWNERSHIP:** STATE  
**COVERTYPE:** ASPEN  
**AGE CLASS:** 50 AND OLDER

<table>
<thead>
<tr>
<th>DISTANCE ZONE (MILES)</th>
<th>PULPWOOD VOLUME (CORDS)</th>
<th>BOLT VOLUME (CORDS)</th>
<th>SAULOG VOLUME (CORDS)</th>
<th>HARVESTABLE BIOMASS (DRY-TONS)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ASPEN</td>
<td>NONASP HWD</td>
<td>ASPEN</td>
<td>NONASP HWD</td>
</tr>
<tr>
<td>&lt; 10</td>
<td>23160</td>
<td>314</td>
<td>15482</td>
<td>314</td>
</tr>
<tr>
<td>11 - 20</td>
<td>16099</td>
<td>18956</td>
<td>16413</td>
<td>16549</td>
</tr>
<tr>
<td>21 - 30</td>
<td>293797</td>
<td>105065</td>
<td>205944</td>
<td>131149</td>
</tr>
<tr>
<td>31 - 40</td>
<td>97552</td>
<td>36155</td>
<td>71552</td>
<td>60019</td>
</tr>
<tr>
<td>41 - 50</td>
<td>103864</td>
<td>47837</td>
<td>83063</td>
<td>82740</td>
</tr>
<tr>
<td>51 - 60</td>
<td>326292</td>
<td>71195</td>
<td>276042</td>
<td>83154</td>
</tr>
<tr>
<td>61 - 70</td>
<td>169459</td>
<td>119077</td>
<td>143704</td>
<td>145556</td>
</tr>
<tr>
<td>71 - 80</td>
<td>183828</td>
<td>48632</td>
<td>155516</td>
<td>52338</td>
</tr>
<tr>
<td>81 - 90</td>
<td>153299</td>
<td>77623</td>
<td>140229</td>
<td>109702</td>
</tr>
<tr>
<td>91 - 100</td>
<td>133164</td>
<td>55947</td>
<td>127399</td>
<td>55203</td>
</tr>
<tr>
<td>101-150</td>
<td>99877</td>
<td>319607</td>
<td>813888</td>
<td>416673</td>
</tr>
<tr>
<td>151-200</td>
<td>193769</td>
<td>126397</td>
<td>136492</td>
<td>179739</td>
</tr>
<tr>
<td>201-300</td>
<td>171069</td>
<td>60672</td>
<td>133097</td>
<td>96525</td>
</tr>
<tr>
<td>&gt; 300</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
APPENDIX D: TABLE 4. VOLUME DISTRIBUTION BY DISCRETE DISTANCE CLASSES

<table>
<thead>
<tr>
<th>DISTANCE ZONE (MILES)</th>
<th>PULPUDD VOLUME (Cords)</th>
<th>BOLT VOLUME (Cords)</th>
<th>SAULOG VOLUME (Cords)</th>
<th>HARVESTABLE BIONASS (DRY-TOHS)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ASPEN</td>
<td>NONASP HUD</td>
<td>ASPEN</td>
<td>NONASP HUD</td>
</tr>
<tr>
<td>&lt; 10</td>
<td>14758</td>
<td>363</td>
<td>12389</td>
<td>363</td>
</tr>
<tr>
<td>11 - 20</td>
<td>14168</td>
<td>18094</td>
<td>11930</td>
<td>17695</td>
</tr>
<tr>
<td>21 - 30</td>
<td>195442</td>
<td>106646</td>
<td>128677</td>
<td>116172</td>
</tr>
<tr>
<td>31 - 40</td>
<td>88787</td>
<td>37037</td>
<td>43767</td>
<td>37710</td>
</tr>
<tr>
<td>41 - 50</td>
<td>77294</td>
<td>38236</td>
<td>43556</td>
<td>60236</td>
</tr>
<tr>
<td>51 - 60</td>
<td>262975</td>
<td>93105</td>
<td>210335</td>
<td>95167</td>
</tr>
<tr>
<td>61 - 70</td>
<td>161419</td>
<td>121888</td>
<td>116427</td>
<td>125369</td>
</tr>
<tr>
<td>71 - 80</td>
<td>148567</td>
<td>48879</td>
<td>110665</td>
<td>59220</td>
</tr>
<tr>
<td>81 - 90</td>
<td>163739</td>
<td>93929</td>
<td>122275</td>
<td>150197</td>
</tr>
<tr>
<td>91 -100</td>
<td>155009</td>
<td>43828</td>
<td>145158</td>
<td>48462</td>
</tr>
<tr>
<td>101-150</td>
<td>895189</td>
<td>302010</td>
<td>654213</td>
<td>399204</td>
</tr>
<tr>
<td>151-200</td>
<td>166311</td>
<td>131475</td>
<td>127890</td>
<td>169206</td>
</tr>
<tr>
<td>201-300</td>
<td>134582</td>
<td>55428</td>
<td>107264</td>
<td>63165</td>
</tr>
<tr>
<td>&gt; 300</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
## Table 5. Volume Distribution by Discrete Cost Classes

<table>
<thead>
<tr>
<th>Year: 1980</th>
<th>Market: Benilde</th>
<th>Ownership: State</th>
<th>Cover Type: Aspen</th>
<th>Age Class: 50 and Older</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Cost Zone</strong></td>
<td><strong>Pulped Wood Volume (Cords)</strong></td>
<td><strong>Bolt Volume (Cords)</strong></td>
<td><strong>Sawlog Volume (Cords)</strong></td>
<td><strong>Harvestable Biomass (Dry-Tons)</strong></td>
</tr>
<tr>
<td>----------</td>
<td>--------</td>
<td>------------</td>
<td>--------</td>
<td>------------</td>
</tr>
<tr>
<td>&lt; 30.00</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>30.00-31.99</td>
<td>103393</td>
<td>41989</td>
<td>48488</td>
<td>33322</td>
</tr>
<tr>
<td>32.00-33.99</td>
<td>254724</td>
<td>47699</td>
<td>193705</td>
<td>67989</td>
</tr>
<tr>
<td>34.00-35.99</td>
<td>286883</td>
<td>25523</td>
<td>185760</td>
<td>28684</td>
</tr>
<tr>
<td>36.00-37.99</td>
<td>240835</td>
<td>46405</td>
<td>132517</td>
<td>59744</td>
</tr>
<tr>
<td>38.00-39.99</td>
<td>133997</td>
<td>36318</td>
<td>68799</td>
<td>41520</td>
</tr>
<tr>
<td>40.00-41.99</td>
<td>353487</td>
<td>61228</td>
<td>166638</td>
<td>60432</td>
</tr>
<tr>
<td>42.00-43.99</td>
<td>315039</td>
<td>70042</td>
<td>184508</td>
<td>69698</td>
</tr>
<tr>
<td>44.00-45.99</td>
<td>181511</td>
<td>25460</td>
<td>114190</td>
<td>57326</td>
</tr>
<tr>
<td>46.00-47.99</td>
<td>110762</td>
<td>33071</td>
<td>73013</td>
<td>44458</td>
</tr>
<tr>
<td>48.00-49.99</td>
<td>163144</td>
<td>10150</td>
<td>66515</td>
<td>24528</td>
</tr>
<tr>
<td>50.00-54.99</td>
<td>100934</td>
<td>30275</td>
<td>83449</td>
<td>32826</td>
</tr>
<tr>
<td>55.00-59.99</td>
<td>62711</td>
<td>23106</td>
<td>48216</td>
<td>29150</td>
</tr>
<tr>
<td>&gt; 60.00</td>
<td>11576</td>
<td>1960</td>
<td>17092</td>
<td>2254</td>
</tr>
</tbody>
</table>
APPENDIX D: TABLE 6. VOLUME DISTRIBUTION BY DISCRETE COST CLASSES


<table>
<thead>
<tr>
<th>TOTAL COST ZONE</th>
<th>PULPWOOD VOLUME (CUBIC FEET)</th>
<th>BOLT VOLUME (CUBIC FEET)</th>
<th>SAWLOG VOLUME (CUBIC FEET)</th>
<th>HARVESTABLE DIOHASS (DRIED-TONS)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ASPEN</td>
<td>NONASP</td>
<td>ASPEN</td>
<td>NONASP</td>
</tr>
<tr>
<td>($/CORD)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 30.00</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>30.00-31.99</td>
<td>366433</td>
<td>83927</td>
<td>296637</td>
<td>117280</td>
</tr>
<tr>
<td>32.00-33.99</td>
<td>210197</td>
<td>68687</td>
<td>171867</td>
<td>95580</td>
</tr>
<tr>
<td>34.00-35.99</td>
<td>329512</td>
<td>57683</td>
<td>254205</td>
<td>84343</td>
</tr>
<tr>
<td>36.00-37.99</td>
<td>289775</td>
<td>92291</td>
<td>289077</td>
<td>167297</td>
</tr>
<tr>
<td>38.00-39.99</td>
<td>248476</td>
<td>70850</td>
<td>206247</td>
<td>119868</td>
</tr>
<tr>
<td>40.00-41.99</td>
<td>285414</td>
<td>72929</td>
<td>215330</td>
<td>90731</td>
</tr>
<tr>
<td>42.00-43.99</td>
<td>330095</td>
<td>89294</td>
<td>286221</td>
<td>109424</td>
</tr>
<tr>
<td>44.00-45.99</td>
<td>204677</td>
<td>59631</td>
<td>176277</td>
<td>116348</td>
</tr>
<tr>
<td>46.00-47.99</td>
<td>122769</td>
<td>30858</td>
<td>103578</td>
<td>50697</td>
</tr>
<tr>
<td>48.00-49.99</td>
<td>74709</td>
<td>27054</td>
<td>46698</td>
<td>64117</td>
</tr>
<tr>
<td>50.00-51.99</td>
<td>161245</td>
<td>49583</td>
<td>137592</td>
<td>90397</td>
</tr>
<tr>
<td>55.00-59.99</td>
<td>37299</td>
<td>7714</td>
<td>43938</td>
<td>10898</td>
</tr>
<tr>
<td>&gt; 60.00</td>
<td>28772</td>
<td>21802</td>
<td>31518</td>
<td>17558</td>
</tr>
</tbody>
</table>
### APPENDIX D: TABLE 7. VOLUME DISTRIBUTION BY DISCRETE COST CLASSES

**YEAR:** 2000  
**MARKET:** BEMIDJI  
**OWNERSHIP:** STATE  
**COVERTYPE:** ASPEN  
**AGE CLASS:** 50 AND OLDER

<table>
<thead>
<tr>
<th>TOTAL COST ZONE ($/CORD)</th>
<th>PULPWOOD VOLUME (CUBIC YARDS)</th>
<th>BOLT VOLUME (CUBIC YARDS)</th>
<th>SAULOG VOLUME (CUBIC YARDS)</th>
<th>HARVESTABLE BIOMASS (DRY-TONS)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ASPEN</td>
<td>NONASP HWD</td>
<td>ASPEN</td>
<td>NONASP HWD</td>
</tr>
<tr>
<td>&lt; 30.00</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>30.00-31.99</td>
<td>341826</td>
<td>128088</td>
<td>235022</td>
<td>139306</td>
</tr>
<tr>
<td>32.00-33.99</td>
<td>263652</td>
<td>77292</td>
<td>186402</td>
<td>131648</td>
</tr>
<tr>
<td>34.00-35.99</td>
<td>385078</td>
<td>140540</td>
<td>336177</td>
<td>156138</td>
</tr>
<tr>
<td>36.00-37.99</td>
<td>272888</td>
<td>149070</td>
<td>227758</td>
<td>180011</td>
</tr>
<tr>
<td>38.00-39.99</td>
<td>337586</td>
<td>112791</td>
<td>265174</td>
<td>142129</td>
</tr>
<tr>
<td>40.00-41.99</td>
<td>295729</td>
<td>106285</td>
<td>211274</td>
<td>114348</td>
</tr>
<tr>
<td>42.00-43.99</td>
<td>334237</td>
<td>106170</td>
<td>292043</td>
<td>143763</td>
</tr>
<tr>
<td>44.00-45.99</td>
<td>300928</td>
<td>95808</td>
<td>289486</td>
<td>162622</td>
</tr>
<tr>
<td>46.00-47.99</td>
<td>83017</td>
<td>56361</td>
<td>59439</td>
<td>66624</td>
</tr>
<tr>
<td>48.00-49.99</td>
<td>58039</td>
<td>27551</td>
<td>37810</td>
<td>57621</td>
</tr>
<tr>
<td>50.00-54.99</td>
<td>173648</td>
<td>67115</td>
<td>146015</td>
<td>106419</td>
</tr>
<tr>
<td>55.00-59.99</td>
<td>31401</td>
<td>8942</td>
<td>25077</td>
<td>12886</td>
</tr>
<tr>
<td>&gt; 60.00</td>
<td>5998</td>
<td>11461</td>
<td>7146</td>
<td>8143</td>
</tr>
<tr>
<td>TOTAL COST ZONE</td>
<td>PULPWOOD VOLUME (CORDS)</td>
<td>BOLT VOLUME (CORDS)</td>
<td>SAWLOG VOLUME (CORDS)</td>
<td>HARVESTABLE BIOMASS (DRY-TOHS)</td>
</tr>
<tr>
<td>----------------</td>
<td>--------------------------</td>
<td>---------------------</td>
<td>-----------------------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td>($/CORD)</td>
<td>ASPEN</td>
<td>NONASP HWD</td>
<td>ASPEN</td>
<td>NONASP HWD</td>
</tr>
<tr>
<td>&lt; 30.00</td>
<td>4728</td>
<td>0</td>
<td>2177</td>
<td>0</td>
</tr>
<tr>
<td>30.00-31.99</td>
<td>267969</td>
<td>146460</td>
<td>179536</td>
<td>138406</td>
</tr>
<tr>
<td>32.00-33.99</td>
<td>219286</td>
<td>98161</td>
<td>142286</td>
<td>124168</td>
</tr>
<tr>
<td>34.00-35.99</td>
<td>272653</td>
<td>137915</td>
<td>214383</td>
<td>136373</td>
</tr>
<tr>
<td>36.00-37.99</td>
<td>244234</td>
<td>135503</td>
<td>181250</td>
<td>157462</td>
</tr>
<tr>
<td>38.00-39.99</td>
<td>319115</td>
<td>113887</td>
<td>227269</td>
<td>172794</td>
</tr>
<tr>
<td>40.00-41.99</td>
<td>254646</td>
<td>95386</td>
<td>197030</td>
<td>119258</td>
</tr>
<tr>
<td>42.00-43.99</td>
<td>337172</td>
<td>148197</td>
<td>239263</td>
<td>197991</td>
</tr>
<tr>
<td>44.00-45.99</td>
<td>254056</td>
<td>46774</td>
<td>226011</td>
<td>88641</td>
</tr>
<tr>
<td>46.00-47.99</td>
<td>63763</td>
<td>64749</td>
<td>37649</td>
<td>72135</td>
</tr>
<tr>
<td>48.00-49.99</td>
<td>41267</td>
<td>12896</td>
<td>35545</td>
<td>30987</td>
</tr>
<tr>
<td>50.00-54.99</td>
<td>151146</td>
<td>78398</td>
<td>133739</td>
<td>93031</td>
</tr>
<tr>
<td>55.00-59.99</td>
<td>22399</td>
<td>2307</td>
<td>13207</td>
<td>5434</td>
</tr>
<tr>
<td>&gt; 60.00</td>
<td>5806</td>
<td>12287</td>
<td>5199</td>
<td>7486</td>
</tr>
</tbody>
</table>
APPENDIX E.

List of microfiches for tables produced by program PROVE\textsuperscript{a}

<table>
<thead>
<tr>
<th>Fiche Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FICHFIG</td>
<td>1980 Cumulative Distance Class Tables</td>
</tr>
<tr>
<td>FICHYWC</td>
<td>1990 Cumulative Distance Class Tables</td>
</tr>
<tr>
<td>FICHYXB</td>
<td>2000 Cumulative Distance Class Tables</td>
</tr>
<tr>
<td>FICHYWR</td>
<td>2010 Cumulative Distance Class Tables</td>
</tr>
<tr>
<td>FICHYYO</td>
<td>1980 Cumulative Cost Class Tables</td>
</tr>
<tr>
<td>FICHYYT</td>
<td>1990 Cumulative Cost Class Tables</td>
</tr>
<tr>
<td>FICHYYG</td>
<td>2000 Cumulative Cost Class Tables</td>
</tr>
<tr>
<td>FICHYYI</td>
<td>2010 Cumulative Cost Class Tables</td>
</tr>
</tbody>
</table>

\textsuperscript{a} Each file contains 80 tables for the following combinations:

(a) 4 ownerships
   - U.S. Forest Service
   - State
   - other public
   - private

(b) 2 covertypes
   - aspen
   - other hardwoods

(c) 1 age class: 50 years and older

(d) 10 markets