ABSTRACT: Step-by-step instructions are provided for using stratified sampling and probability proportional to size (P.P.S.) in resource inventories. This method is useful when sampling type islands from type maps is desired.

1. INTRODUCTION

Type maps delineating soil and/or vegetation differences are a common tool for planning many resource activities. Often each type island is measured by using a cluster of either randomly or systematically located plots. It is however, becoming prohibitively expensive to sample each and every one of these mapped polygons, particularly when large areas are involved.

Many agencies, including the BLM, successfully use some form of stratified sampling to efficiently conduct resource inventories. In stratified sampling, units of a population (inventory unit) are grouped together on the basis of similar characteristics. These groups are called strata. Each stratum is then sampled for additional attributes. The stratum estimates are combined to give a population estimate.

By stratifying we divide our heterogeneous inventory unit of type islands into homogeneous subunits. Such an act enables us to obtain satisfactory estimates of the inventory unit as a whole with less field work than if we did not stratify.

Strata may be formed along many lines, i.e., volumes, vegetation types, administrative units, etc. They should however;
A. Be logically related to item or items of information sought.
B. Must exist in nature or have been artificially established.
C. Represent a relative homogeneous condition which can be defined in specific terms.
D. Should have differentiating criteria easily recognizable from aerial photos, maps and from the ground.
E. Represent a grouping that the manager definitely wants sampled on the ground.
F. Be meaningful to the manager.
G. Be formulated as closely as possible to accepted definitions.

Each and every type island or site must fall into one and only one sampling strata.

Some resource inventories, such as BLM's soil-vegetation inventory method (SVIM) utilize homogeneously mapped soil-vegetation and condition class areas to form sampling strata. These mapped areas may be looked upon as "plots" of varying size and are the units to be sampled. As these type islands, sites or site write-up areas (SMA) do vary in size, some unbiased procedure for selecting the samples within each stratum is desirable. One method is to use sampling based upon probability proportional to size (P.P.S.).

This paper provides step-by-step procedures and examples for use of P.P.S. and stratified sampling. The methods are patterned after Freese (1962) and are not new to those familiar with sampling.

Instructions are given for: determining sampling intensity, i.e., how many sites or typed areas need to be sampled; how to select the sample sites; and how to expand the sampled data to the stratum and population level. Both volume estimates and area estimates are illustrated.

II. ASSUMPTIONS

Assume that we have an inventory unit consisting of 6698 acres. The unit has been mapped into sites and stratified into 3 strata of either grass, shrub or shrub-grass combinations. There are a total of 45 sites in all varying in size from 26 acres to 880 acres (Table 1). Our objective is to determine the average forage production per acre in pounds for the total


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population (all 6698 acres). From pre-inventory planning we find we want our estimate to be within ± 75 pounds per acre unless a 1 in 3 chance of a poor sample occurred.

To keep our numbers to a minimum, we’ll express this 75 pounds in 100 pound units for the rest of this paper. Hence we’ll want to be within ± 0.75 100 pounds/acre. This 0.75 is our allowable error(ε) or the maximum difference we can tolerate between the sample or estimated forage production and the true quantity that exists.

We will group our population of sites into three strata, grass, shrub and shrub-grass, and select sites within each stratum for sampling based upon probability proportional to size. The sites having the larger acreage will have a greater chance of being sampled if the field than those with smaller acreage. (Figure 1)

Each site selected is considered a plot. The measurement of each sample type island would proceed as normally done. If a systematic cluster is normally used, then the site will carry the mean value of the cluster. That mean value would be used in all calculations. Variation within the site is essentially ignored. We will select only enough sites to be measured in the field to achieve the allowable error stated above.

III. DETERMINING SAMPLING INTENSITY

To determine the sampling intensity for a stratified sample, we need to know the desired allowable error (E) of the estimate we are interested in and the confidence level.

The confidence level sets limits on how often we’ll be right in our estimate of forage production in the long run. In our examples here - we’ll set the confidence limits at one standard error or 67%. We are betting odds our sample will be right two out of three times. This is essentially the degree of risk we are willing to accept in sampling.

We’ll also need to know the size (A) in acres of each strata and the variance (S^2) of sites within each strata.

The allowable error (E) has been previously listed. Table 2 shows a listing of the sites and their areas by stratum. In addition we’ve accumulated the acres in each strata for each stratum for use further on.

The only item that we have to determine, therefore, is the estimated variance (S^2) for each stratum.

A. Determine Stratum Variance

The expected variance (S^2) can be roughly approximated by the formula

\[ S^2 = \left( \frac{R}{A} \right)^2 \]

where R is the estimated or known range from the smallest to the largest production likely to be encountered in sampling the strata.

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### Table 2. Listing of Sites, Area & Accumulates

<table>
<thead>
<tr>
<th>Site No.</th>
<th>Site Name</th>
<th>Site Location</th>
<th>Site Size (Acres)</th>
<th>Site Accumulate (Tons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>001</td>
<td>Site A</td>
<td>Acres 1</td>
<td>74</td>
<td>74</td>
</tr>
<tr>
<td>002</td>
<td>Site B</td>
<td>Acres 2</td>
<td>74</td>
<td>74</td>
</tr>
<tr>
<td>003</td>
<td>Site C</td>
<td>Acres 3</td>
<td>74</td>
<td>74</td>
</tr>
<tr>
<td>004</td>
<td>Site D</td>
<td>Acres 4</td>
<td>74</td>
<td>74</td>
</tr>
<tr>
<td>005</td>
<td>Site E</td>
<td>Acres 5</td>
<td>74</td>
<td>74</td>
</tr>
<tr>
<td>006</td>
<td>Site F</td>
<td>Acres 6</td>
<td>74</td>
<td>74</td>
</tr>
<tr>
<td>007</td>
<td>Site G</td>
<td>Acres 7</td>
<td>74</td>
<td>74</td>
</tr>
<tr>
<td>008</td>
<td>Site H</td>
<td>Acres 8</td>
<td>74</td>
<td>74</td>
</tr>
<tr>
<td>009</td>
<td>Site I</td>
<td>Acres 9</td>
<td>74</td>
<td>74</td>
</tr>
</tbody>
</table>

### Table 3. Strata Means and Variance Based on Field Sample

<table>
<thead>
<tr>
<th>Strata</th>
<th>A</th>
<th>E</th>
<th>(100 lbs/acre)</th>
<th>µ</th>
<th>(µ)^2</th>
<th>(A)²</th>
<th>(µ)²</th>
<th>(A)²</th>
<th>(µ)²</th>
</tr>
</thead>
<tbody>
<tr>
<td>000</td>
<td>100</td>
<td>90</td>
<td>100</td>
<td>90</td>
<td>100</td>
<td>100</td>
<td>90</td>
<td>100</td>
<td>90</td>
</tr>
</tbody>
</table>

### Table 4. Strata Means and Variance per Area

<table>
<thead>
<tr>
<th>Strata</th>
<th>A</th>
<th>E</th>
<th>(100 lbs/acre)</th>
<th>µ</th>
<th>(µ)^2</th>
<th>(A)²</th>
<th>(µ)²</th>
<th>(A)²</th>
<th>(µ)²</th>
</tr>
</thead>
<tbody>
<tr>
<td>001</td>
<td>100</td>
<td>90</td>
<td>100</td>
<td>90</td>
<td>100</td>
<td>100</td>
<td>90</td>
<td>100</td>
<td>90</td>
</tr>
</tbody>
</table>

### Table 5. Strata Means and Variance for Area

<table>
<thead>
<tr>
<th>Strata</th>
<th>A</th>
<th>E</th>
<th>(100 lbs/acre)</th>
<th>µ</th>
<th>(µ)^2</th>
<th>(A)²</th>
<th>(µ)²</th>
<th>(A)²</th>
<th>(µ)²</th>
</tr>
</thead>
<tbody>
<tr>
<td>001</td>
<td>100</td>
<td>90</td>
<td>100</td>
<td>90</td>
<td>100</td>
<td>100</td>
<td>90</td>
<td>100</td>
<td>90</td>
</tr>
</tbody>
</table>

---
1. Grass Strata

Based on experience, or observation, we estimate the range for forage production to be between 2 to 16 (100 lbs./acre). Hence: \( s^2_{\text{Grass}} = \left( \frac{16}{4} \right)^2 = 12.15 \)

2. Shrub Strata

We anticipate the production to run between 3 to 10 (100 lbs./acre). Therefore: \( s^2_{\text{Shrub}} = \left( \frac{10}{2} \right)^2 = 3.0625 \)

3. Shrub/Grass Strata

Estimated production range is 5-10 (100 lbs./acre). Therefore: \( s^2_{\text{Shrub/Grass}} = \left( \frac{5}{2} \right)^2 = 1.5625 \)

B. Construct the following summary:

<table>
<thead>
<tr>
<th>Strata</th>
<th>Area in Strata (A)</th>
<th>Variance in Strata (s^2)</th>
<th>A x s^2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grass</td>
<td>4063</td>
<td>12.25</td>
<td>49771.75</td>
</tr>
<tr>
<td>Shrub</td>
<td>2515</td>
<td>3.0625</td>
<td>7702.19</td>
</tr>
<tr>
<td>Shrub/Grass</td>
<td>120</td>
<td>1.5625</td>
<td>187.50</td>
</tr>
<tr>
<td>Σ</td>
<td>6698</td>
<td></td>
<td>57661.44</td>
</tr>
</tbody>
</table>

C. Determine number of samples (n) from

\[ n = \frac{\Sigma (A x s^2)}{\Sigma (A^2 x \bar{s}^2) + \Sigma (A x s)^2} \]

\[ n = \frac{6698 \times 57661.44}{(6698^2 \times 0.75^2) + 57661.44} \]

\[ n = \frac{386,216,325.1}{44,863,204 \times 0.56} + 57661.44 \]

\[ n = \frac{386,216,325.1}{25,235,592.25 + 57661.44} \]

\[ n = \frac{386,216,325.1}{25,293,231.69} \]

\[ n = 15.26 \text{ samples} \]
Distribute samples proportionally to each stratum (Ns) (as a minimum each stratum must have at least two samples).

\[ n_s = \frac{A_s}{\sum A_s} \times n \]

For Grass Strata.

\[ n_g = \frac{4063}{6698} \times 15.26 = 9.2 \approx 10 \text{ (rounded up).} \]

For Shrub Strata.

\[ n_s = \frac{2515}{6698} \times 15.26 = 5.7 = 6 \]

For Shrub/Grass.

\[ n_s = \frac{120}{6698} \times 15.26 = 0.27 = 1 \text{ increase to 2} \]

Total samples = 18

IV. SELECT SAMPLE SITES AND MEASURE

To select sites from within each strata to be sampled, use accumulated acres in Table 2 and a systematic sample with a random start.

A. Determine sampling interval (I_s) and random start number for each strata.

\[ I_s = \frac{A_s}{N_s} \rightarrow \text{whole number rounded down} \]

Random number is selected from 1 and \( I_s + \text{Remainder} \) (R).

1. For Grass

\[ I_g = \frac{4063}{10} = 406 \text{ (7) with 3 Remainder} \]

Random number is selected from \( I_g + R_g = 406 + 3 = 409 \). From random table select start of sample between 1 and 409. Random start = 391.

Site having accumulated acres (Table 2) of 391 in grass strata is the first sample. This is site 007.

The next site will be at acre 391 + 406 = 797 which is site 010.

Each addition site is selected by adding 406 to previous figure. Continue until all samples are selected.

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The site is included in the sample when the sample acre is equal to or less than the cumulative sum for that site and greater than the cumulative sum for the preceding site.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Sample Acre</th>
<th>Site No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>391</td>
<td>007</td>
</tr>
<tr>
<td>2</td>
<td>797</td>
<td>010</td>
</tr>
<tr>
<td>3</td>
<td>1203</td>
<td>010</td>
</tr>
<tr>
<td>4</td>
<td>1609</td>
<td>011</td>
</tr>
<tr>
<td>5</td>
<td>2015</td>
<td>013</td>
</tr>
<tr>
<td>6</td>
<td>2421</td>
<td>013</td>
</tr>
<tr>
<td>7</td>
<td>2827</td>
<td>015</td>
</tr>
<tr>
<td>8</td>
<td>3233</td>
<td>027</td>
</tr>
<tr>
<td>9</td>
<td>3639</td>
<td>034</td>
</tr>
<tr>
<td>10</td>
<td>4045</td>
<td>064</td>
</tr>
</tbody>
</table>

*Note - Some sites, because of their size may have more than one sample indicated. The same site mean production value will be used for each sample within the site. In the example above, site 10 and site 13 will each have their mean production value counted twice in further computations although they would be measured in the field only once.

B. For Shrub

\[ I_s = \frac{2515}{6} = 419 (1) + 1 \text{ Remainder} \]

Select random no. from 1 and 420. Random start = 149.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Sample Acre</th>
<th>Site No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>149</td>
<td>008</td>
</tr>
<tr>
<td>2</td>
<td>568</td>
<td>022</td>
</tr>
<tr>
<td>3</td>
<td>987</td>
<td>028</td>
</tr>
<tr>
<td>4</td>
<td>1406</td>
<td>031</td>
</tr>
<tr>
<td>5</td>
<td>1825</td>
<td>031</td>
</tr>
<tr>
<td>6</td>
<td>2244</td>
<td>038</td>
</tr>
</tbody>
</table>

C. For Shrub/Grass

\[ I_s = \frac{120}{2} = 60 (1) + 0 \text{ Remainder} \]

Select random no. from 1 and 60. Random start = 17.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Sample Acre</th>
<th>Site No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>17</td>
<td>001</td>
</tr>
<tr>
<td>2</td>
<td>77</td>
<td>039</td>
</tr>
</tbody>
</table>

2 total sites
V. COMPUTE STATISTICS

A. For each strata you'll have to compute the sample strata mean $\bar{X}$ and variance $S^2$ and the standard deviation $S_i$.

$$\bar{X}_i = \frac{\sum X_i}{n_i} \quad \text{where } X_i = \text{measured production/acre in field for each site.}$$

$$S_i^2 = \frac{\sum X_i^2 - (\sum X_i)^2}{n_i - 1}$$

$$S_i = \sqrt{S_i^2}$$

1. For Grass Strata

<table>
<thead>
<tr>
<th>Sample</th>
<th>Site</th>
<th>Production/Ac</th>
<th>Product$^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>007</td>
<td>7.6</td>
<td>57.76</td>
</tr>
<tr>
<td>2</td>
<td>010</td>
<td>11.1</td>
<td>123.21</td>
</tr>
<tr>
<td>3</td>
<td>010</td>
<td>11.1</td>
<td>123.21</td>
</tr>
<tr>
<td>4</td>
<td>011</td>
<td>7.0</td>
<td>49.00</td>
</tr>
<tr>
<td>5</td>
<td>013</td>
<td>9.6</td>
<td>92.16</td>
</tr>
<tr>
<td>6</td>
<td>013</td>
<td>9.6</td>
<td>92.16</td>
</tr>
<tr>
<td>7</td>
<td>015</td>
<td>8.6</td>
<td>43.56</td>
</tr>
<tr>
<td>8</td>
<td>027</td>
<td>9.1</td>
<td>9.61</td>
</tr>
<tr>
<td>9</td>
<td>034</td>
<td>13.2</td>
<td>174.24</td>
</tr>
<tr>
<td>10</td>
<td>044</td>
<td>3.3</td>
<td>12.25</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>82.4</td>
<td>777.16</td>
</tr>
</tbody>
</table>

$$\bar{X}_i = \frac{82.4}{10} = 8.24 \ (100 \text{ lbs/Ac})$$

$$S_i^2 = \frac{777.16 - (82.4)^2}{10 - 1}$$

$$S_i^2 = \frac{777.16 - 678.98}{9}$$

$$S_i^2 = 10.91$$

$$S_i = \sqrt{10.91} = 3.30 \ (100 \text{ lbs/Ac})$$
2. For Shrub Strata

<table>
<thead>
<tr>
<th>Sample</th>
<th>Site</th>
<th>Production/Ac (Xi) (100 lbs)/Ac</th>
<th>Production² (Xi²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>008</td>
<td>4.6</td>
<td>21.16</td>
</tr>
<tr>
<td>2</td>
<td>022</td>
<td>7.5</td>
<td>56.25</td>
</tr>
<tr>
<td>3</td>
<td>024</td>
<td>4.1</td>
<td>16.81</td>
</tr>
<tr>
<td>4</td>
<td>031</td>
<td>5.5</td>
<td>30.25</td>
</tr>
<tr>
<td>5</td>
<td>031</td>
<td>5.5</td>
<td>30.25</td>
</tr>
<tr>
<td>6</td>
<td>038</td>
<td>5.0</td>
<td>25.00</td>
</tr>
</tbody>
</table>

\[ \bar{X}_1 = \frac{32.2}{6} = 5.37 \text{ (100 lbs)/Ac} \]

\[ S_1^2 = \frac{179.72 - (32.2)^2}{6 - 1} = 172.81 \]

\[ S_1^2 = 1.38 \]

\[ S_1 = 1.18 \text{ (100 lbs)/Ac} \]

3. For Shrubs/Grass Strata

<table>
<thead>
<tr>
<th>Sample</th>
<th>Site</th>
<th>Production/Ac (Xi) (100 lbs)/Ac</th>
<th>Production² (Xi²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>001</td>
<td>8.4</td>
<td>70.56</td>
</tr>
<tr>
<td>2</td>
<td>039</td>
<td>5.8</td>
<td>33.64</td>
</tr>
</tbody>
</table>

\[ \bar{X}_2 = \frac{14.2}{2} = 7.1 \text{ (100 lbs)/Ac} \]

\[ S_1^2 = \frac{104.2 - (14.2)^2}{2 - 1} = 100.82 \]

\[ S_1^2 = 3.38 \]

\[ S_1 = 1.84 \text{ (100 lbs)/Ac} \]

B. Assemble results into format shown in Table 3.

C. Compute the total production and average production for the total area in the unit.

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Total production (100 lbs)/Ac = \sum As (Xi) / (100 lbs) = 47836.67
Mean production/acre = \sum As / As = 7.142

D. Compute the standard error of the estimate.

Standard error of mean = \sqrt{\frac{1}{N} \left( \sum (A_s)^2 \right) - \frac{\sum (A_s)^2}{N}^2}

= \sqrt{\frac{1}{6698} \left( 19,498,331.92 \right) - \frac{19,489,331.92}{6698}^2}

= \sqrt{\frac{19,489,331.92}{44,863,204}}

= 0.659 (100 lbs)/Ac

E. Conclusion

As a rough rule we can say that unless \( \xi \) 1 in 3 chance has occurred, the production mean is included in the range 7.142 \( \pm 0.659 \) (100 lbs)/Ac or 6.483 to 7.801 (100 lbs)/Ac.

We therefore, achieved our goal of obtaining an estimate that was within \( \pm 0.75 \) (100 lbs)/Ac at one standard deviation.

VI. AREA ESTIMATES

The preceding section dealt with generating volume or production estimates. Often there is a need to generate area estimates as well. For example, how much productive forest land is there? How much area is there by soil type? What is the acreage of poor condition land, etc.?

These type estimates may be obtained from the sampled sites by developing proportions.

For example, assume that in the samples we have just completed, we determined soil type as well. For one reason or another, we want to know what proportion of the allotment is in soil type 454 and what is the reliability of the estimate. The following are the step-by-step procedures.

A. List sample by strata with soil type
### B. Next find the proportion ($P_s$) of samples within each stratum having soil 451.

Number of samples with characteristic $N_s$:

1. For grass. 7 out of the 10 samples had soil 451.
   \[
   P_{s,\text{Grass}} = \frac{7}{10} = 0.7
   \]

2. For shrub.
   \[
   P_{s,\text{Strub}} = \frac{0}{6} = 0
   \]

3. For Shrub/Grass.
   \[
   P_{s,\text{Shrub/Grass}} = \frac{2}{2} = 1
   \]

Each proportion also serves as the stratum mean ($\bar{x}_i$).

### C. Next determine the proportion ($Q_s$) of samples in each stratum that are not soil 451.

Number of samples not soil 451 $Q_s$:

1. For Grass.
   \[
   Q_{s,\text{Grass}} = 1 - 0.7 = 0.3
   \]
2. For Shrub.
   \[ Q_{\text{Shrub}} = 1 - 0 = 1 \]

3. For Shrub/Grass
   \[ Q_{\text{Shrub/Grass}} = 1 - 1 = 0 \]

D. Determine variance for each strata.
   \[ S_t^2 = P_\text{s} \times Q_\text{s} \]

1. For Grass.
   \[ S_{\text{Grass}}^2 = 0.7 \times 0.1 = 0.21 \]

2. For Shrub.
   \[ S_{\text{Shrub}}^2 = 0 \times 1 = 0 \]

3. For Shrub/Grass
   \[ S_{\text{Shrub/Grass}}^2 = 1 \times 0 = 0 \]

E. Assemble results into Table 4.
   The proportion of the allotment having soil 451 is 2964.1/6698 = 0.443.

F. The total area of soil type 451 in the inventory unit is 2964.1 acres.

G. The standard error of the proportion estimate is equal to:
   \[
   \sqrt{\frac{1}{(\hat{p} \times \hat{a})^2} \left( \frac{(\hat{a})^2 \times S_t^2}{N_\text{s}} \right)}
   \]

   \[
   = \sqrt{\frac{1}{6098^2} \times 346667.34}
   \]

   \[
   = \sqrt{\frac{346667.34}{44863204}} = \sqrt{0.0077}
   \]

   \[= 0.088 \]
IV. Summary

There are several sampling options available when conducting inventories based upon type maps. The system presented here utilized stratification to keep variation to a minimum.

Individual type islands were considered as potential plots of varying sizes. Consequently samples within strata had to be chosen based upon probability proportional to size. Procedures and examples were given for determining sampling intensity and generating statistical estimates.

The system has utility both in single purpose and multi-resource inventories which utilize type maps as an inventory base.


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Current Literature

Please order directly from addresses given.

General

Station Note No. 28 "Idaho-Land-Use Mapping from LANDSAT Tranparencies"


Pub. No. 16 "Full Forest Utilization - A Bibliography". All from College of Forestry, Wildlife and Range Sciences, University of Idaho, Moscow, ID 83843.

The August 1978 issue of the Journal of Forestry has several interesting articles including:

"Forest Survey and the Nonindustrial Private Ownships" by Tarrant, Ewing and Gedeney

"Judging Recreation Impacts on Wilderness Campsites" by Frissell

"Measuring Trail Conditions with Stereo Photography" by Rinehart, Hardy and Rosenau

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Check for copies at your local conservation library.


Reprint - "Land Classification as a Base for Integrated Inventories of Renewable Resources" by Gimbargevsky.

Information Rept. FMR-X-110 "Current Progress in Research on Terrain Properties" by Golob. Both from Forest Management Institute, Canadian Forestry Service, 396 Cooper St., Ottawa, Ontario, Canada K1A 0W2.


Data Processing

The College of Forestry at University of Minn. has developed a forest sampling simulator that has been used successfully in their teaching program. A description of the program, how to use it and a listing (microfiche) are available as Staff Paper #4 from the Department of Forest Resources, College of Forestry. Send inquiries to:

Dr. Dietmar Rose
University of Minnesota
College of Forestry
110 Green Hall
St. Paul, MN 55108


Forestry

Reprint - "Demonstration of the Applicability of Satellite Data to Forestry"
Reprint - "A Method of National Forest Inventory in Northern Finland" by Peso and Kujala are available from Metsantukkimuslaitos, Unioninkatu 40 A, SF-00170 Helsinki 17, Finland.


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"An Analytical Look at the Log Volume Formulas" by Alemad.

Information Report FMR X-112 "The Forest Management Institute Tree Data Bank"

Reprint - "An Evaluation of Systematic Sampling in Malaysian Forest Inventories" by Bonno. All from Forest Management Inst., Canadian Forestry Service, 396 Cooper St. Ottawa, Ontario, Canada K1A 0W2.

78-17 "Analysis of 11 Years Growth of Caribbean Pine in a Replicated Grace Latin Square Spacing - Thinning Experiment in Suriname" by Be Vries. Hildebrand and DeGraaff from Forest Mensuration Dept., Agricultural University, Wageningen, The Netherlands.

"Remote Sensing"

TAFHE RSL Research Report 78-1 "Operating Manual for the Montana 35 MM Aerial Photography System - 2nd Revision"

TAFHE RSL Research Report 78-2 "A Wetlands Survey of the Twin Cities 7-County Metropolitan Area-East Half"

Contact TAFHE Remote Sensing Laboratory, Univ. of Minn., College of Forestry, 1530 North Cleveland Ave., St. Paul, MN 55108 for availability.

Reprint - "A Poor Man's Digital Image Interpretation System" by Peet and Wightman from Forest Management Inst., Canadian Forestry Serv., 396 Cooper St., Ottawa, Ontario, Canada K1A 0W2.
Wildlife

Two new Tech. Notes in Habitat Management Series for Unique or Endangered Species - No. 16 - The Black Hawk and No. 17 The Accipiters - will be available shortly. Drop us a line, Attn: D-360 for copies.


Meetings

Forest Growth and Yield Workshop. Sponsored by the SAF Inventory Working Group and University of New Hampshire will be held Nov. 29 thru Dec. 1, 1978 at Durham, NH. The regional workshop designed as an introductory course for forest managers and analysts who need to implement growth and yield methodology in a decision-making role. Enrollment will be limited to 25 on a first-come basis. Registration and fees will be between $50-100. For details contact Dr. James Barrett, INER, James Hall, University of New Hampshire, Durham, NH 03824.

Introduction to Renewable Resource Inventory Methods, will be presented March 5-9, 1979, at the University of California. Berkeley.

The course focuses on the inventory design process, emphasizing sampling and measurement systems and the integration of aerial photography, satellite spectral data and conventional ground data into such systems. Forest and rangeland inventory problems will be used to illustrate the principles and techniques discussed in lecture and workshop sessions. Workshop exercises will cover sampling skills, aerial photography and satellite imagery for stratification, and measurement techniques applicable to large and medium-scale photography.

Enrollment is limited, and participants will be selected on the basis of their field of inventory interest and their job responsibilities. For details write: Division of Letters and Sciences, University of California Extension, 2223 Fulton St., Berkeley, CA 94720, or call (415) 642-1061. The fee will be $350.

Sampling Designs for Successive Inventories. A workshop sponsored by Colorado State University Dept. of Forest and Wood Sciences and the SAF Inventory Working Group will be held July 16-20, 1979. Registration will be $300. Contact the Office of Conferences and Institute, Rockwell Hall, Colorado State University, Fort Collins, CO 80523 for details.

1979 Forest Inventory Workshop - National meeting sponsored by SAF, ILEFRO and Colorado State University is slated for July 23-27. Watch the "Notes" for further developments and plan to attend.
A IUFRO meeting on Estimation of Increment will be held September 9-15, 1979 in Vienna at the Forstliche Bundesversuchsanstalt, Schombrunn-Tirolergarten. The general theme of the meeting is "The growth of single trees and the development of stands as common objects of growth research and inventory". For more details, contact:
Paul Schmid-Haas
Swiss Forest Research Institute
CH 8903 Birmensdorf
Switzerland

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Wanted! Lead articles, current literature and meeting announcements for publishing in the "Notes". If announcing a meeting, please allow at least a four month lag time.

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