Resource Inventory Notes

BLM 15

Nov. 1978

TYPE MAPS,
STRATIFIED SAMPLING AND P.P.S.

by

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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.

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I. 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;

Published by:

USDI, Bureau of Land Management, D 340
Denver Service Center, Denver Federal Center, Bldg. 50
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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 homogenous 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 (SWA) do vary in size, some unbiased procedure for selecting the samples within each stratum is desirable. One method is to use sampling based upon <u>probability</u> <u>proportional</u> to <u>size</u> (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)[1] 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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[1] Freese, Frank, 1962, Elementary Forest Sampling, USDA Agri. Handbook 232, 91 pp.

Figure 1 - Location of type islands or sites within inventory unit.

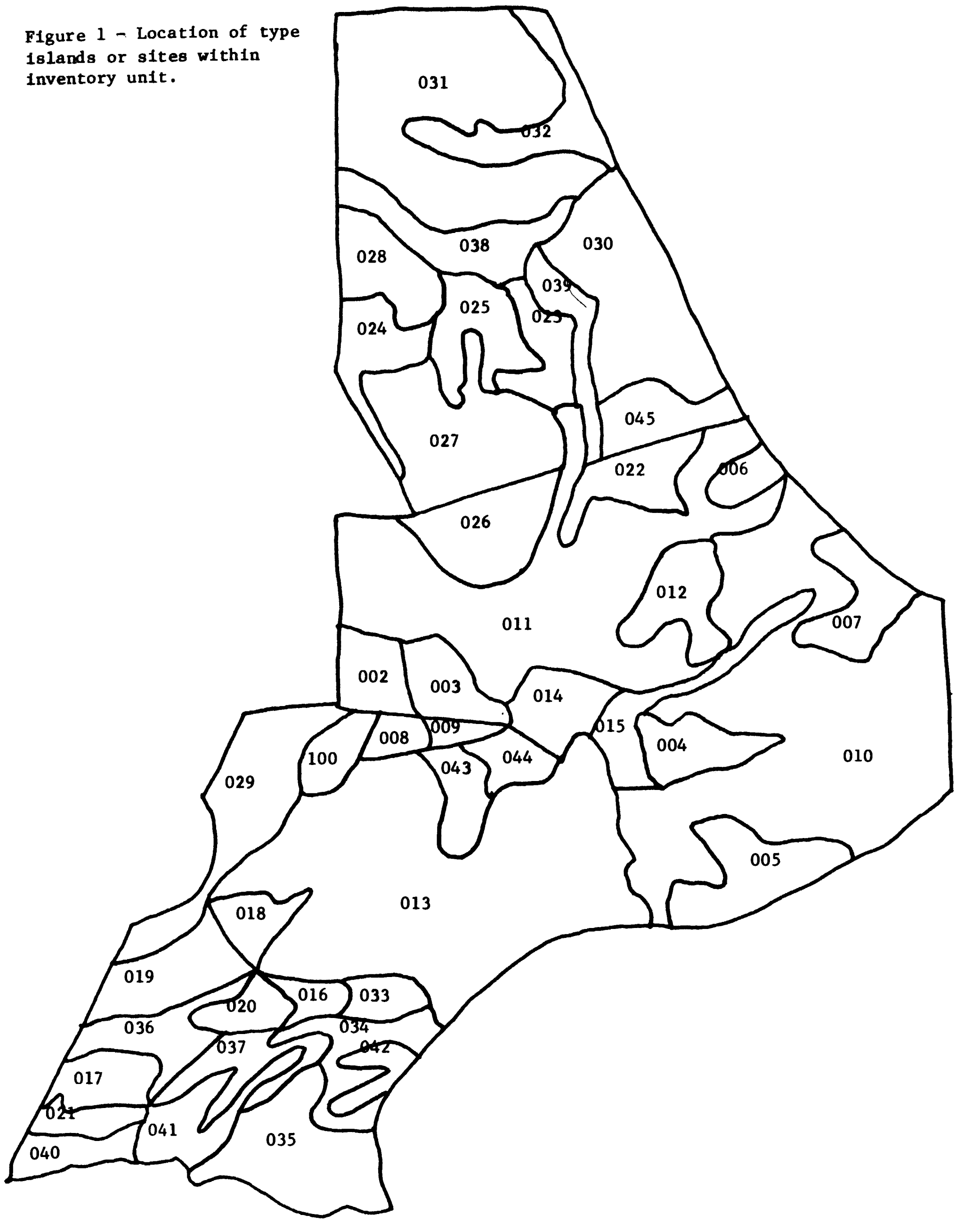

Table 1 Listing of Sample Units by Size and Strata

Site ID	Size in Acres	Strata (Veg. Type)
001	64	Shrub/Grass
002	74	Shrub
003	74	Grass
004	88	Grass
005	124	Grass
006	32	Shrub
007	120	Grass
008	26	Shrub
009	26	Grass
010	880	Grass
011	500	Grass
012	88	Grass
013	852	Grass
014	64	Grass
015	64	Grass
016	50	Shrub
017	80	Shrub
018	65	Shrub
019	128	Shrub
020	52	Shrub
021	35	Grass
022	132	Shrub
023	90	Shrub
024	96	Shrub
025	96	Shrub
026	152	Grass
027	170	Grass
028	128	Shrub
029	300	Grass
030	332	Shrub
031	580	Shrub
032	100	Shrub
033	72	Grass
034	88	Grass
035	208	Grass
036	82	Shrub
037	82	Shrub
038	92	Shrub
039	56	Shrub/Grass
040	56	Grass
041	36	Shrub
042	40	Grass
043	62	Shrub
044	62	Grass
045	100	Shrub
Σ	6698	

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$^{(E)}$ or the maximum difference we can tolerate between the sampled 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 in 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_s) in acres of each strata and the variance ($S_s{}^2$) 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 site within each stratum for use further on.

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

A. Determine Stratum Variance

The expected variance ($S_s{}^2$) can be roughly approximated by the formula

$S_s{}^2 = \left(\frac{R}{4} \right)^2$ where R is the <u>estimated</u> or known range from the smallest to the largest production likely to be encountered in sampling the strata.

Table 2. Listing of Sites, Area & Accumulative Area Within Stratum

STRATUM								
GRASS			SHRUB			SHRUB/GRASS		
Site No.	Size (Acres)	Accum. Acres	Site No.	Size (Acres)	Accum. Acres	Site No.	Size (Acres)	Accum. Acres
003	74	74	002	74	74	001	64	64
004	88	162	006	32	106	039	56	120
005	124	286	008	26	132			
007	120	406	016	50	182			
009	26	432	017	80	262			
010	880	1312	018	65	327			
011	500	1812	019	128	455			
012	88	1900	020	52	507			
013	852	2752	022	132	639			
014	64	2816	023	90	729			
015	64	2880	024	96	825			
021	35	2915	025	96	921			
026	152	3067	028	128	1049			
027	170	3237	030	332	1381			
029	300	3537	031	580	1961			
033	72	3609	032	100	2061			
034	88	3697	036	82	2143			
035	208	3905	037	82	2225			
040	56	2961	038	92	2317			
042	40	4001	041	36	2353			
044	62	4063	043	62	2415			
			045	100	2515			
(21)	4063		(22)	2515		(2)	120	

Table 3. Strata Means and Variances Based on Field Samples

Strata	As	$\bar{X}i$ (100 lbs)/Ac	Si^2	Ns	As ($\bar{X}i$) Total Production (100 lbs)/Ac	$\frac{(As)^2\ Si^2}{Ns}$
GRASS	4063	8.24	10.91	10	33,479.12	18,010,194.17
SHRUB	2515	5.37	1.38	6	13,505.55	1,454,801.75
SHRUB/GRASS	120	7.10	3.38	2	852.00	24,336.00
Σ	6698			18	47,836.67	19,489,331.92

Table 4. Strata Means and Variances For Area Estimates of Soil Types

Strata	As	$\bar{X}i$	Si^2	Ns	As Xi	$\frac{(As)^2\ (Si^2)}{Ns}$
GRASS	4063	0.7	0.21	10	2844.1	346,667.34
SHRUB	2515	0	0	6	0	0
SHRUB/GRASS	120	1	0	2	120	0
Σ	6698			18	2964.1	346,667.34

1. Grass Strata

Based on experience, or observation, we estimate the range for forage production to be between 2 to 16 (100 lbs.)/acre. R, therefore, = 14 Hence: $S^2_{Grass} = \left(\frac{14}{4}\right)^2 = 12.25$

2. Shrub Strata

We anticipate the production to run between 3 to 10(100 lbs)/acre. Therefore: $S^2_{Shrub} = \left(\frac{7}{4}\right)^2 = 3.0625$

3. Shrub/Grass Strata

Estimated production range is 5-10 (100 lbs)/acre. Therefore: $S^2_{Shrub/Grass} = \left(\frac{5}{4}\right)^2 = 1.5625$

B. Construct the following summary:

Strata	Area in Strata (As)	Variance in Strata (Ss^2)	As X Ss^2
Grass	4063	12.25	49771.75
Shrub	2515	3.0625	7702.19
Shrub/Grass	120	1.5625	187.50
Σ	6698		57661.44

C. Determine number of samples (n) from

$$n = \frac{\Sigma\ (As) \times \Sigma\ (As \times Ss^2)}{(\Sigma\ (As)^2 \times E^2) + \Sigma\ (As \times S_s{}^2)}$$

$$n = \frac{6698 \times 57661.44}{(6698^2 \times .75^2) + 57661.44}$$

$$n = \frac{386{,}216{,}325.1}{(44{,}863{,}204 \times 0.56) + 57661.44}$$

$$n = \frac{386{,}216{,}325.1}{25{,}235{,}552.25 + 57661.44}$$

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

n = 15.26 samples

D. Distribute samples proportionally to each stratum (Ns) (as a minimum each stratum must have at least two samples).

$$n_s = \frac{As}{\Sigma\ As} \times n$$

For Grass Strata.

$$n_s = \frac{4063}{6698} \times 15.26 = 9.2 = 10 \text{ (rounded up).}$$

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.

Where

$$I_s = \frac{As}{Ns} = \text{ to whole number rounded down}$$

Random number is selected from 1 and I_s + Remainder (R).

1. For Grass

$$I_s = \frac{4063}{10} = 406 \text{ (I) with 3 Remainder}$$

Random number is selected from $I_s + R_s$ = 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.

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.

Sample	Sample Acre	Site No.
1	391	007
2	797	010) *
3	1203	010)
4	1609	011
5	2015	013) *
6	2421	013)
7	2827	015
8	3233	027
9	3639	034
10	4045	044

8 total sites to be visited

*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

$I_s = \frac{2515}{6} = 419\ (I) + 1$ Remainder

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

Sample	Sample Acre	Site No.
1	149	008
2	568	022
3	987	028
4	1406	031) *
5	1825	031)
6	2244	038

5 total sites

C. For Shrub/Grass

$I_s = \frac{120}{2} = 60\ (I) + 0$ Remainder

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

Sample	Sample Acre	Site No.
1	17	001
2	77	039

2 total sites

D. After sample sites are selected - go to field and measure those attributes including the production in which you are interested. In this example, while 18 samples were chosen, only 15 sites need to be measured. Some sites, as indicated above, will have double weight or greater because of their size.

V. COMPUTE STATISTICS

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

$$\bar{X}_i = \frac{\Sigma X_i}{n_s}$$ where Xi = measured production/acre in field for each site.

$$Si^2 = \frac{\Sigma Xi^2 - \frac{(\Sigma Xi)^2}{n_s}}{n_s - 1}$$

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

1. For Grass Strata

Sample	Site	Production/Ac (Xi) (100 lbs)/Ac	Production^2 (Xi^2)
1	007	7.6	57.76
2	010	11.1	123.21
3	010	11.1	123.21
4	011	7.0	49.00
5	013	9.6	92.16
6	013	9.6	92.16
7	015	6.6	43.56
8	027	3.1	9.61
9	034	13.2	174.24
10	044	3.5	12.25
Σ 10		82.4	777.16

$$\overline{Xi} = \frac{82.4}{10} = 8.24 \text{ (100 lbs)/Ac}$$

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

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

$$Si^2 = 10.91$$

$$Si = \sqrt{10.91} = 3.30 \text{ (100 lbs)/Ac}$$

2. For Shrub Strata

Sample	Site	Production/Ac (Xi) (100 lbs)/Ac	Production^2 (Xi^2)
1	008	4.6	21.16
2	022	7.5	56.25
3	028	4.1	16.81
4	031	5.5	30.25
5	031	5.5	30.25
6	038	5.0	25.00
Σ 6		32.2	179.72

$$\overline{Xi} = \frac{32.2}{6} = 5.37 \quad (100\ \text{lbs})/\text{Ac}$$

$$Si^2 = \frac{179.72 - \frac{(32.2)^2}{6}}{6 - 1}$$

$$Si^2 = \frac{179.72 - 172.81}{5}$$

$$Si^2 = 1.38$$

$$Si = 1.18 \quad (100\ \text{lbs})/\text{Ac}$$

3. For Shrubs/Grass Strata

Sample	Site	Production/Ac (Xi) (100 lbs)/Ac	Production^2 (Xi^2)
1	001	8.4	70.56
2	039	5.8	33.64
Σ 2		14.2	104.20

$$\overline{Xi} = \frac{14.2}{2} = 7.1 \quad (100\ \text{lbs})/\text{Ac}$$

$$Si^2 = \frac{104.2 - \frac{(14.2)^2}{2}}{2 - 1}$$

$$Si^2 = 104.2 - 100.82$$

$$Si^2 = 3.38$$

$$Si = 1.84 \quad (100\ \text{lbs})/\text{Ac}$$

B. Assemble results into format shown in Table 3.

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

Total production (100 lbs)/Ac $= \Sigma \text{ As } (\overline{X}i)$
$= 47836.67$ (100 lbs)

Mean production/acre $= \dfrac{\Sigma \text{ As } (\overline{X}i)}{\Sigma \text{ As}} = \dfrac{47836.67}{6698}$

$= 7.142$ (100 lbs)/Ac

D. Compute the standard error of the estimate.

$$\text{Standard error of mean} = \sqrt{\frac{1}{(\Sigma \text{ As})^2} \left(\Sigma \frac{(\text{As})^2 \ \text{Si}^2}{\text{Ns}} \right)}$$

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

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

$$= \sqrt{0.4344}$$

$$= 0.659 \quad (100 \text{ lbs})/\text{Ac}$$

E. Conclusion

As a rough rule we can say that unless a 1 in 3 chance has occurred, the production mean is included in the range 7.142 ± 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 ± 0.75 (100 lbs)/Ac at one standard deviation.

VI. AREA ESTIMATES

The preceeding 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 451 and what is the reliability of the estimate. The following are the step-by-step procedures.

A. List sample by strata with soil type

GRASS			SHRUB			SHRUB/GRASS		
Sample No.	Site	Soil	Sample No.	Site	Soil	Sample No.	Site	Soil
1	007	451	1	008	TX0197	1	001	451
2	010	451	2	022	125	2	039	451
3	010	451	3	028	114			
4	011	451	4	031	114			
5	013	451	5	031	114			
6	013	451	6	038	127			
7	015	TX0197						
8	027	451						
9	034	114						
10	044	TX0197						

B. Next find the proportion (Ps) of samples within each stratum having soil 451.

$$Ps = \frac{\text{Number samples with characteristic}}{Ns}$$

1. For grass. 7 out of the 10 samples had type 451.

$$Ps_{Grass} = \frac{7}{10} = 0.7$$

2. For shrub.

$$Ps_{Shrub} = \frac{0}{6} = 0$$

3. For Shrub/Grass.

$$Ps_{Shrub/Grass} = \frac{2}{2} = 1$$

Each proportion also serves as the stratum mean $(\bar{X}i)$

C. Next determine the proportion (Qs) of samples in each stratum that are <u>not</u> soil 451.

$$Qs = 1 - Ps$$

1. For Grass.

$$Q_{Grass} = 1 - 0.7 = 0.3$$

2. For Shrub.

$Q_{Shrub} = 1 - 0 = 1$

3. For Shrub/Grass

$Q_{Shrub/Grass} = 1 - 1 = 0$

D. Determine variance for each strata.

$Si^2 = Ps \times Qs$

1. For Grass.

$S^2_{Grass} = 0.7 \times 0.3 = 0.21$

2. For Shrub.

$S^2_{Shrub} = 0 \times 1 = 0$

3. For Shrub/Grass.

$S^2_{Shrub/Grass} = 1 \times 0 = 0$

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:

$$\sqrt{\frac{1}{(\Sigma\ As)^2} \quad \left(\Sigma \frac{(As)^2 \ \ Si^2}{Ns} \right)}$$

$$= \sqrt{\frac{1}{6698^2} \times 346667.34}$$

$$= \sqrt{\frac{346667.34}{44863204}} = \sqrt{.0077}$$

$$= 0.088$$

H. Conclusion

As a rough rule we can say that unless a 1 in 3 chance has occurred the proportion of the allotment having soil type 451 is 0.443 ± 0.088 or ranges between 0.355 to 0.531. If we multiply these figures times the total area, the estimate of area having soil 451 falls between 2377.79 to 3556.64 acres with the estimate (mean) being 2964.1.

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 probablility 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 2/which utilize type maps as an inventory base.

2/ Lund, H. Gyde. 1978. Inplace Multiple Resource Inventories at Budget Prices. Resource Inventory Notes, BLM 13, p. 1-7.

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Current Literature

Please order directly from addresses given.

General

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

Mis. Pub. #5. "The RARE II Process in Idaho: A Procedure for Evaluating Resource Tradeoffs".

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

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

"Forest Survey and the Nonindustrial Private Ownerships" by Tarrant, Ewing and Gedney

"Judging Recreation Impacts on Wilderness Campsites" by Frissell

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

"Mensuration Research for Improved Management of New Zealand's Exotic Forests" by Burkhart and Beekhuis.

Check for copies at your local conservation library.

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Tech. Bull. T-148 "The Use of Markov Process in Estimating Land-Use Change" from Agric. Exp. Sta., Oklahoma State Univ., Stillwater, OK 74074.

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

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.

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Misc. Pub. 153 "Economic Feasibility Analysis What Is It and How Should It Be Done" from Coop. Exten. Service, Univ. of Hawaii, Manoa, Honolulu, HI 96822.

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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

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Bull. 105 "A Computerized Method for Abstracting and Evaluating Environmental Impact Statements". Contact Virginia Water Resources Research Center, 225 Norris Hall, VPI and State Univ., Blacksburg, VA 24061 for price and availability.

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Forestry

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

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Res. Rept. No. 61 "Computer and Tabular Growth Simulation of Mixed Conifer-Hardwood Stands in the Northeast".

Res. Rept. No. 62 "Biomass Estimation Equations and Nutrient Composition of White Pine, White Birch, Red Maple and Red Oak in New Hampshire". Both from Agricultural Exp. Station, Taylor Hall, Univ. of NH, Durham, NH 03824.

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G77-383 "Marketing your Timber" from Extension Service, University of Nebraska-Lincoln, Lincoln, NE 68583.

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Rept. ER-78 -1 "Tree Power - An Assessment of The Energy Potential of Forest Biomass in Canada".

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

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

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

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

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Protection

Tech. Bull 236 "Keys for the Identification of Parasitic Insects in Arizona Agricultural Areas" and Res. Rept. 276 "Monitoring Insect Parasites in a Cotton Pest Management Program" from Coop. Exten. Service, Univ. of Arizona, Tucson, AZ 85721.

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Information Rept. N-X-148 "Wood Defect and Density Studies of Living Trees: 1-Field Guide" from Newfoundland Forest Res. Ctr., P.O. Box 6028, St. John's, Newfoundland, Canada A1C 5X8.

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Remote Sensing

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

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

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

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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.

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Reprint - "Digital Image Analysis Techniques Required for Natural Resource Inventories" by Wayne G. Rohde from USDI Geological Survey, EROS Data Center, Sioux Falls, SD 57198.

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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.

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Misc. Rept. 152-1978 "Equipment and Methods for Radio Tracking Freshwater Fish" from Agric. Exp. Sta., Univ. of Minnesota, St. Paul, MN 55108.

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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.

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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.

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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, Forest Collins, CO 80523 for details.

1979 Forest Inventory Workshop - National meeting sponsored by SAF, IUFRO and Colorado State University is slated for July 23-27. Watch the "Notes" for further developments and plan to attend.

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A IUFRO meeting on Estimation of Increment will be held September 9-15, 1979 in Vienna at the Forsthiche Budesversuchsanstalt, Schonbrunn-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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