INFO an item of interest

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Resource Inventory Notes

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INFORMATION NEEDED AND THE DESIGN OF AN INVENTORY

By: Evert W. Johnson

An inventory of one or more of the resources associated with forest land should be carefully designed so as to provide the needed information at the desired level of precision and at the lowest cost. Unfortunately such designing is rarely done and, as a consequence, the inventories are often unnecessarily costly and/or time-consuming and in some cases may actually fail to provide some of the needed information. Before he can design an efficient inventory the mensurationist must have detailed knowledge of the purpose of the inventory, the specific uses that will be made of the data obtained, and the precision levels desired. This information provides the foundation on which the inventory design will be built. It also imposes constraints on certain aspects of the operation. It may be a thought-provoking exercise to consider how these requirements of the inventory user may influence planning and design of the inventory.

Let us examine the seemingly simple matter of a timber cruise. What are some of the decision-requiring activities that are dependent on information obtained from timber cruises? One might list the following examples: setting of a minimum price for the timber on a tract of land; purchase of timber or timberland; choosing a mill site; development of a classical timber management plan; and scheduling of cutting operations using some optimizing procedure. The requirements for information differ from one example to another. Though a single cruise design (e.g., line-plot or point-sampling along cruise lines) probably could be used in all of these cases, it is not likely that it would be the most efficient in every case. To achieve optimum efficiency it would be necessary to develop an appropriate design for each situation. Considerable variation in the manner of conducting the cruises would undoubtedly result. Let us consider how the requirements of the aforementioned cases might influence the designs.

The author is Professor of Forestry, School of Agriculture and the Agriculture Experiment Station, Auburn University, Auburn, Alabama.

If the cruise is to be used by a timber-growing organization as the basis for setting a minimum price on a block of timber to be sold on the basis of competitive bids, the primary requirement is for an estimate of total volumes by species. The allowable sampling error for the most important species, which should be specified, would likely be relatively large and its associated probability relatively low. Since spatial distribution of timber on the tract would be immaterial, a map would not be made. Any areal information needed for volume estimation could be obtained directly from aerial photographs by sampling procedures.

On the other hand, if the cruise is to be used as the basis for arriving at a bid for the purchase of a large tract of timber by an industrial organization, the requirements may be somewhat different and this should be reflected in the design. Again, the primary requirement is an estimate of total volume by species. However, sampling intensity might be based on sampling errors stated for several different species. Furthermore, it is likely that these allowable sampling errors would be smaller than those used by the seller and that their associated probabilities would be higher. Therefore, a higher sampling intensity than that of the seller's cruise would be required. The importance of spatial arrangement of the timber on operability might be sufficient to require construction of a stand map. The map might also show surface configuration in some form. The reason for higher precision and the map is that the buyer is bidding in competition and needs the best possible information upon which to base his decision. Since the cost of the inventory will not be recovered if the purchase is not made, efficiency is mandatory.

If the land itself is part of the purchase package, its productive capability should be assessed. This would require a classification and evaluation of site quality in addition to the timber volume estimate. It also would require an evaluation of the non-merchantable timber present and, perhaps, some sort of growth study. In this case, site quality and vegetative condition class maps would be essential.

If the cruise is to be used as the basis for computer assisted harvest scheduling, its nature will be dramatically different from the inventories described above. Each harvesting unit must be identified and volume and area information specific to each of these units must be obtained. Harvesting units may be conventional stands, survey units such as sections or forties, land units bounded by roads and/or streams, or watersheds. Since each harvesting unit is a separate problem, it is unlikely that allowable errors would be used to control cruise intensity. Costs of a statistically controlled sample in each unit usually would be prohibitively high. The actual sample size assigned to each unit might be based on a constant cruise intensity or it could be an arbitrary constant. Areas of the individual harvesting units will be required. A stand map made from aerial photographs would be the best source of such areas, particularly if the terrain is rough.

If the cruise is intended for a classical management plan, the design will again be different. Information regarding volumes per acre by species and condition classes will be required. Total volumes by species are necessary for compartments and working circles, but need not be specific to stands. It would be perfectly satisfactory to develop condition class volumes on a per acre basis, by species, and then to apply them to the condition class area in the individual management units. Cruise intensity should vary by condition class in a manner so as to be positively correlated with volume or value. Statistical control with allowable sampling errors and probability levels that change from class to class could be used. Alternatively, cruise intensity might be determined by some non-statistical method that is sensitive to both area and volume or value. Condition class areas, by compartments and/or working circles, would have to be determined. This could be accomplished directly from aerial photographs using sampling procedures or from stand maps made from the aerial photographs.

Finally, if the purpose of the cruise is to evaluate the timbershed about a potential or actual mill site, it must be designed to require a minimum amount of ground work because entry into a multiplicity of ownerships is a critical factor. Obtaining entry permission consumes valuable time. Failure to obtain such permission can be decidedly unhealthy! The principal requirement of the timbershed cruise would be an estimate of total volume, by species. A relatively large allowable sampling error for the most important species or group of species probably would be stated and its associated probability probably would be low. There would be no need whatsoever for a stand map. The sampling design undoubtedly would make use of multiphase stratified sampling. The strata would be broad, involving only 5 or 6 categories, exclusive of the non-timbered areas and forest lands with unmerchantable timber cover. Areas of these two land-use categories, in addition to those of the operational strata, would be estimated in order to provide a complete picture of the timbershed. These areas would probably be estimated using a large sample of random points located on aerial photographs. This area estimation would form the first phase in the multiphase sampling operation. In the second phase, a randomly chosen subsample of area determination points, only in the strata containing merchantable timber, would be used as centers of sample plots on the photographs. The volumes of these plots would be estimated using the photographic evidence. The third and last phase would be based on a randomly chosen subsample of the photo-evaluated plots. These plots would be located in the field and cruised in a conventional manner. Data from the plots cruised both ways would be used to develop a regression or ratio by which the photo-estimate of volume per unit area could be corrected. Heavy reliance is placed on photographic information in this proposed design in order to reduce field operations to a minimum.

As can be seen from these examples, there are many ways to carry out a timber cruise. The same is true for inventories of any resource associated with forest land. The procedure chosen should fit the situation so as to provide all the needed information while costing as little as possible. Remember that inventories in themselves are not productive. They yield income only for those who carry them out, and they can be very expensive. It only makes sense to design every inventory so carefully that it is likely to accomplish the desired results at a minimum cost.

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CURRENT LITERATURE

Reprint, "Developing a Wetland Classification for Canada", and Information Report O-X-215, "Toward a Wetland Classification for Ontario", are available from Information Services, Great Lakes Forest Research Centre, Canadian Forestry Service, P. O. Box 490, Sault Ste. Marie, Ontario, P6A 5M7.

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Several publications on remote sensing and inventory are available from the Forest Management Institute, Canadian Forestry Service, 396 Cooper Street, Ottawa, Ontario, K1A 0W2. These include:

- Reprint, "Interpretation of Remote Sensing Imagery in the Evaluation of Forest Land", by Gimbarzevsky.
- Paper, "Lansat Applications in Canadian Forestry", by Sayn-Wittgenstein.
- Paper, "ERTS Thematic Map from Multidate Digital Images", by Kalensky.
- Information Report FMR-X-81, "Biophysical Survey of Kejimkukik National Park", by Gimbarzevsky.
- Information Report FMR-X-84, "A Technique for Locating Ground Calibration Data on Image 100 Output", by F. G. Peet.
- Paper, "A Primer on the Use of Digital Landsat Data" by F. G. Peet.
- Information Report FMR-X-70, "A System for the Computation and Presentation of Line-Plot Data for the Assessment of Growth" by I. S. Alemdag.

.Information Report FMR-X-72, "Inventory-Oriented Stand Development Tables for Northern Ontario Pulpwood Cover Types" by F. Evert.

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Texas Forestry Paper No. 2, "SFA Plantation Inventory Program", and Paper No. 21, "Estimating Cubic Foot Volume, Green Weight, or Dry Weight per Acre of Planted Loblolly Pine Using Variable-Radius-Plot Cruising Techniques", are available from School of Forestry, Stephen F. Austin State University, Nacogdoches, Texas, 75961.

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Research Note SE-231, "North Carolina's Timberland Acreage is Declining"; Resource Bulletin SE-33, "North Carolina's Timber, 1974"; Reprint, "The Precision and Repeatability of a Leaf Biomass Sampling Technique for Mixed Hardwood Stands", by Lloyd and Olson; and Research Paper SE-127, "Fusiform Rust: Forest Survey Incidence Data and Financial Impact in the South", are available from the Southeastern Forest Experiment Station, P. O. Box 2570, Asheville, North Carolina, 28892.

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Research Note NE-166, "Forest Survey Cubic Foot Volume Equations", by Barnard, Bickford and Mayer; Resource Bulletin NE-41, "The Forest Land Owners of Southern New England", by Neal Kingsley; and Research Paper NE-339, "Suitability of the Line Intersect Method for Sampling Hardwood Logging Residues", by Jeff Martin are available from the Northeastern Forest Experiment Station, 6816 Market Street, Upper Darby, Pennsylvania, 19082.

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Research Note NC-195, "Forest Area in Iowa Counties, 1974", by Burt Essex and Research Paper NC-118, "Vertebrate Animal Populations of the McCormick Forest", by Robinson and Werner are available from the North Central Forest Experiment Station, Folwell Avenue, St. Paul, Minnesota, 55101.

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Resource Bulletins SO 55 & 56, "Alabama's Timber Resources updated, 1975", and "Arkansas' Timber Resources updated, 1975" are available from the Southern Forest Experiment Station, T-10210 Federal Building, 701 Loyola Avenue, New Orleans, Louisiana, 70113.

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Harry Wiant and Bill Maxey have reprints available on "Estimating Timber Volumes Without Equipment" and "Cruise Sawtimber Without Diameter Measurements". These are available from the Division of Forestry, West Virginia University, Morgantown, West Virginia, 26506.

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Technical Bulletin 73, "Estimating Weights of Loblolly Pine Trees and their Components in Natural Stands and Plantations in Central Mississippi", by Nelson and Switzer is available from Mississippi Agricultural and Forest Experiment Station, Mississippi State, Mississippi, 39762.

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"Forestland Grazing - A Guide for Service Foresters in the South" describes resource inventory techniques, management of the ranges and cattle management. This is available from USDA Forest Service, State and Private Forestry, Southeastern Area, 1720 Peachtree Road, N. W., Atlanta, Georgia, 30309.

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Final Report, Project W-17-7, "Mountain Goat Survey Technique Evaluation", by Warren Bullard is available from Alaska Department of Fish and Game, Juneau, Alaska.

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"RPA - The Nation's Renewable Resources - An Assessment, 1975" describes the inventory of present and potential resources of the United States, including an analysis of the present situation and outlook for (1) outdoor recreation and wilderness, (2) wildlife and fish, (3) forest-range grazing, (4) timber, and (5) water. Copies may be obtained from Chief, Forest Service, U. S. Department of Agriculture, South Building, Room S-159, 12th and Independence Avenue, Washington, D. C., 20250.

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The American Society of Photogrammetry has recently published Volumes I and II of the Manual of Remote Sensing. Volume I, "Theory, Instruments, and Techniques", deals with the basics of remote sensing, sensor systems, processing and management, and the effect of atmospheric and other factors on remote sensing. Volume II, "Interpretation and Applications", includes chapter devoted to natural resources inventory. The two-volume set may be ordered from the Society at 105 North Virginia Avenue, Falls Church, Virginia, 22046. The cost is about $35.00 for the complete set.

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Multispectral Photography for Earth Resources by Yost, Wenderoth, Kalia, and Anderson. 1974. 278 pages. Write Remote Sensing Information Center, P. O. Box 176, Greenvale, New York, 11548, for price.

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AES Information Series No. 12, "Soilscrapes Interpreted from Landsat Imagery" is available from Agricultural Experiment Station, South Dakota State University, Brookings, South Dakota, 57006.

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Two paperback books that are a must in an inventory library are "Sampling" by Morris James Slonim (Simon and Schuster, Inc., 630 Fifth Avenue, New York, New York, 10020), and "How to Lie with Statistics" by Darrell Huff (W. W. Norton and Company, Inc., 500 Fifth Avenue, New York, New York, 10036). Both books have been around for quite some time. "Sampling" explains statistics in very simple and humorous terms. "How to Lie with Statistics" is useful in preparing factual reports. It is also easily read and very humorous. Prices for the books may be obtained from the publishers.

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MEETINGS

IUFRO

Just a reminder that the International Union of Forest Research Organizations will hold its 1976 Congress in Oslo, Norway, June 19 - July 3. The "Application of EDP in Forest Inventory" working group will hold its work session on June 22. For further information, contact: Professor T. Cunia, School of Environment and Resource Management, State University of New York, Syracuse, New York, 13210.

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Mathematical Programming and Systems Model

The College of Forestry and Natural Resources at Colorado State University will be holding two one-week short courses for natural resource managers and planners this summer at Fort Collins. These will be Introduction to Mathematical Programming, to be held July 12-23, and Systems Models for Natural Resource Planning and Management, to be held July 26-30. Similar workshops at CSU have been very instructive. For further information, contact: Office of Conferences and Institutes, Residential Conference Center, Colorado State University, Fort Collins, Colorado, 80523.

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Resource Data Management

The Society of American Foresters' Inventory and Systems Analysis Working Groups will be co-sponsoring a "Resource Data Management Symposium" with the Purdue University Department of Forestry and Natural Resources. The symposium will be held August 17 and 18, 1976, at Purdue. The objective is to introduce the concept and potential of formal data management systems in natural resources management. The program is aimed at middle management, technical staff, or their equivalents in public and private land management organizations. For further information, contact Dr. John Moser, Department of Forestry and Natural Resources, Purdue University, West Lafayette, Indiana, 47907.

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MISCELLANEOUS

Have some information you want included in Resource Inventory Notes? Send it or any inquiries to U. S. Forest Service, State and Private Forestry, 6816 Market Street, Upper Darby, Pennsylvania, 19082, Attention: Resource Inventory Notes.

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