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Forest Service Handbook 1909.14 – Resource Inventory Handbook

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Periodic information is required for all land, soil, timber, forage, water, air, fish and wildlife, aesthetics, recreation, wilderness, and energy and mineral resources on all forest and rangelands in the United States for developing the Resources Planning Act (RPA) assessment, program, and subsequent Regional guides and National Forest plans. Resource inventories provide much of the required information.

The purpose of this handbook is to identify the inventory-derived information that may be needed for the 1999 Resources Planning Act assessment and National Forest planning, and to provide guidance to ensure that inventories of land, soil, timber, forage, water, air, fish and wildlife, aesthetics, recreation, wilderness, and energy and mineral resources are conducted in an effective way.

Coordinated or integrated resource inventories provide efficient, compatible, and valid data and information that describe the resources and their conditions, potential, and trends. Information from the inventories may provide input to the Resources Planning Act (RPA) national assessment, National Forest plans, comprehensive State-wide forest plan assessments, and may be used for project planning where such data are appropriate. Coordinated or integrated resource inventories promote data sharing among resource managers and decision makers.

Use this information in conjunction with direction in FSM 1390, FSM 1910, FSM 1920, FSM 2060, FSM 4810 and functional resource direction in all of the titles of FSM Series 2000 - National Forest Resource Management.

01 - Authority

The following acts require and authorize resource inventories for national assessments and land and resource management planning.

1. Fish and Wildlife Coordination Act of 1934 (ch. 55, 48 Stat. 401, as amended; 16 U.S.C. 661, 662(a), 662(h), 663(c), 663(f)). This act authorizes surveys and investigations of the wildlife of the public domain lands including lands and waters of interest therein acquired or controlled by any agency of the United States.

2. Wilderness Act of 1964 (P.L. 88-577, 78 Stat. 890; 16 U.S.C. 1121 (note), 1131-1136). Section 3 permits the gathering of resource information in wilderness areas.

3. National Environmental Policy Act of 1969 (P.L. 91-190, 83 Stat. 852; U.S.C. 4321 (Note), 4321, 4331-4335, 4341-4347). Section 102 directs that all agencies of the Federal Government shall utilize a systematic, interdisciplinary approach with will insure the integrated use of of the natural and social sciences and the environmental design arts in planning and in decisionmaking which may have an impact on man's environment.

4. Endangered Species Act of 1973. (P.L. 93-205, 87 Stat. 884, as amended; 16 U.S.C. 1531-1536, 1538-1540). Section 6 directs each Federal Agency to conduct biological assessments for the purpose of identifying any endangered or threatened species.

5. Forest and Rangeland Renewable Resources Planning Act of 1974 (P.L. 93-378, 88 Stat. 476, as amended; 16 U.S.C. 1601 (Note), 1600-1614). Sections 3-7 and 12 require the Forest Service and other federal agencies conduct inventories of present and potential renewable resources, utilize information and data available from other Federal, state, and private organizations, and avoid duplication and overlap of resource assessment and program planning efforts. The law further requires a comprehensive and appropriately detailed inventory of all National Forest System lands and renewable resources.

6. Federal Land Policy and Management Act of 1976 (P.L. 94-579, 90 Stat. 2743, as amended; 43 U.S.C. 1701 (Note), 1701, 1702, 1712, 1714-1717, 1719, 1732b, 1740, 1744, 1745, 1751-1753, 1761, 1763-1771, 1781, 1782; 7 U.S.C. 1212a; 16 U.S.C. 478a, 1338a). This act requires that public lands and their resources be periodically and systematically inventoried and that an evaluation of the current natural resource use and values be made of adjacent public and nonpublic land.

7. National Forest Management Act of 1976 (P.L. 94-588, 90 Stat. 2949, as amended; 16 U.S.C. 472a, 476, 500, 513-516, 518, 521b, 528 (Note), 576b, 594-2 (Note), 1600 (Note), 1601 (Note), 1600-1602, 1604, 1606, 1608-1614). Sections 2, 6(f)(3), and 6(g)(2)) emphasize the stipulations of the Renewable Resources Planning Act of 1974. The act also requires that the Forest Service establish quantitative and qualitative standards and guidelines for land and resource planning and management. Inventories shall include quantitative data making possible the evaluation of diversity in terms of its prior and present condition.

8. Clean Air Act Amendments of 1977 (P.L. 95-95, 91 Stat. 685, as amended; 42 U.S.C. 7401, 7418, 7470, 7472, 7474, 7475, 7491, 7506, 7602). Sections 162 and 165 require a classification of monitoring of Federal lands for air quality.

9. Soil and Water Conservation Act of 1977 (P.L. 95-192, 91 Stat. 1407; 16 U.S.C. 2001-2009). Section 5 authorizes the Federal Government to obtain and maintain information of the current status of soil, water, and related resources. The act further requires an integrated system capable of using combinations of resource data to determine the quality and capabilities for alternative uses of the resource base and to identify areas of local, State, and National concerns.

10. Forest and Rangeland Renewable Resources Research Act of 1978 (P.L. 95-307, 92 Stat. 353, as amended; 16 U.S.C. 1600 (Note), 1641-1647). Section 3b authorizes the Forest Service to conduct renewable resource surveys on state and private lands.

11. Cooperative Forestry Assistance Act of 1978 (P.L. 95-313, 92 Stat. 365; 16 U.S.C. 2101 (Note)). Section 8 authorizes the Forest Service to assist State agencies in the assembly, analysis, display and reporting of state resource data.

12. Public Rangelands Improvement Act of 1978 (P.L. 95-514, 92 Stat. 1806; 43 U.S.C. 1752-1753, 1901-1908; 16 U.S.C. 1333(b)). Section 4 directs the Forest Service to inventory and identify current public rangelands conditions and trends as part of the inventory process required by Section 201 (a) of the Federal Land and Management Act of 1976 (43 U.S.C. 1711) and to keep such inventories current.

13. Energy Security Act of 1980 (P.L. 96-294, 94 Stat. 611; 42 U.S.C. 8801 (Note), 8854, 8855 Sec. 261). This act emphasizes the need for biomass information for energy projects.

14. National Materials and Mineral Policy, Research and Development Act of 1980 (P.L. 96-479, 94 Stat 2305; 30 U.S.C. 1601-1605).

15. Forest Ecosystems and Atmospheric Pollution Research Act of 1988 (P.L. 100-521, 102 Stat 2601; 16 U.S.C. 1680 (Note)). Section 3 directs the Forest Service to increase the frequency of forest inventories in matters that relate to atmospheric pollution and conduct such surveys as are necessary to monitor long-term trends in the health and productivity of domestic forest ecosystems.

02 - Objective

The Forest Service conducts integrated or coordinated resource inventories in order to: (1) determine the condition, production, potential, and amounts of key ecosystem components or processes; (2) identify a bench mark for describing the current physical and biological situation and for forecasting projected changes; (3) provide ecological information as a basis for protection and management decisions about land and resource uses, proposed plans, or actions; (4) consider conditions and trends that (a) change the demand for resources or (b) are affected by resource decisions; and (5) refer all inventoried information to specific units of land.

03 - Policy

1. Use existing data where feasible or design coordinated inventories to meet the essential data and information requirements for Resource Planning Act (RPA) assessment, State forest resource plan assessment, and State or National Forest land and resource management planning needs (FSM 1390).

2. Use international and national definitions and standards in designing, implementing, and maintaining the inventories to ensure that multifunctional data have a common frame of reference and to ensure consistency of information between planning levels.

3. Use established methods and terminology where interagency cooperative agreements exist.

4. Use and interpret inventories in a manner consistent with the design, sampling intensity, and nature of the data collected.

04 - Responsibilities

04.1 - Deputy Chiefs, Research and National Forest System

The Deputy Chiefs shall establish accuracy standards and goals for the inventories conducted by the Forest Inventory and Analysis research units and for those conducted on the National Forest System lands.

04.2 - Washington Office Staff Directors

Washington Office Staff Directors shall:

1. Ensure that the standards and rules for resource inventory are uniformly and correctly applied.

2. Develop interagency coordination and standardization of land and resource inventories.

04.3 - Regional Foresters and Station Directors

Regional Foresters and Station Directors shall:

1. Maintain current inventories and periodically evaluate existing data for validity.

2. Coordinate inventory planning and data collection activities. Avoid duplication of data collection and ensure the use of the most efficient inventory designs to meet management objectives. Develop linkages between inventories used for state and National Forest planning and the inventories conducted by Forest Inventory and Analysis research units or others.

3. Define boundaries of inventory units.

4. Develop an inventory schedule for each inventory unit.

5. Ensure data are compatible and comparable with other Forest Service inventories. Promote sharing of information and technology between cooperators.

6. Issue Regional or Station supplements to this handbook to ensure inventory coordination and quality control. Specify inspection standards, limits of acceptable measurement errors, and procedures for correcting unacceptable errors.

7. Assist in technology transfer and information sharing activities after resource inventories have been completed.

04.31 - Regional Foresters

Regional Foresters, through Forest Supervisors, are responsible for the inventory for protection and management purposes of all land, soil, timber, forage, water, air, fish and wildlife, aesthetics, recreation, wilderness, and energy and mineral resources on all National Forests and National Grasslands. To meet these responsibilities the Regional Forester shall:

1. Establish and maintain required Resources Planning Act assessment data bases.
2. Coordinate with appropriate Station Directors and other Federal and State agencies having inventory responsibilities to eliminate duplication of data collection and to promote data sharing.
3. Develop and maintain a catalog of inventories done within the Region and monitor the effectiveness of each inventory.
4. Develop a Regional data dictionary and a list of variable descriptions that will document the content and descriptions of all inventories of National Forest System lands and renewable resources within the Region.
5. Develop a Regional bibliography referencing documents on the content and description of inventories on National Forest System lands.
6. Coordinate and review quality control of ongoing inventories.
7. Assist in planning State inventories to ensure that State planning information needs are being met and coordinate technology transfer activities after resource inventories have been completed.

04.32 - Station Directors

Station Directors shall:

1. In consultation with Deputy Chief for Research, establish and maintain accuracy standards and goals for State-wide forest surveys conducted by Forest Inventory and Analysis research units.

2. Through Forest Inventory and Analysis Project Leaders, collect and maintain inventory statistics on the land, soil, timber, forage, water, air, fish and wildlife habitat, aesthetics, recreation, wilderness, and energy and mineral resources of all forested lands in the United States, and having such responsibility:

- a. Establish and maintain Resource Planning Act assessment data bases.
- b. Coordinate with Regional Foresters and other Federal and State agencies having inventory responsibilities to minimize duplication of data collection and to promote data sharing.
- c. Cooperate with other Federal and State agencies to establish an accurate estimate of land use and land cover area statistics.
- d. When appropriate, conduct landowner surveys.

04.33 - Area Director

The Area Director shall assist in planning State inventories to ensure that State planning information needs are being met and coordinate technology transfer activities after resource inventories have been completed.

05 - Definitions

1. Accuracy. The success of estimating the true value of a quantity.
2. Analysis Area. One or more capability areas grouped together for the purpose of conducting analysis.
3. Bias. Systematic distortion of a statistic as a result of sampling or measurement procedures.
4. Capability Area. An identifiable, contiguous area of land that, because of its characteristics, responds to the effects of management relatively the same throughout its area.
5. Classification. The process of assigning objects to categories based on their natural affinities to one another.
6. Coordinated Inventories. Simultaneously collecting information needed by a number of resource functions.
7. Cost Effective. Achieving specified outputs for objectives under given conditions for the least cost.

8. Ecosystem. The interacting system of a biological community and its nonliving environment; a biological community, together with its environment.

9. Integrated Inventory. An inventory or group of inventories designed to meet multiple needs for information.

10. Inventory. Collection of data for analysis of the status or conditions of resources or other vegetative or physical characteristics required for planning and implementing protection and management activities.

11. Inventory (Survey) Unit. The land unit containing the population of objects or attributes for which information is to be summarized and analyzed. For national assessments and land and resource management planning, the inventory unit is usually the planning area, Forest, or State. For local projects or other planning needs, the unit may consist of any area of land such as grazing allotments, compartments, watersheds, lakes, 40-acre parcels, or discrete vegetative stands.

12. Management Area. One or more capability or analysis areas or portions thereof.

13. Map Unit. See Sampling Unit.

14. Monitoring. The process of detecting change over time with the intent of recommending management adjustments if needed.

15. Multiresource Inventory. An inventory designed to describe two or more components of the total resources (1) in a single data collection effort or (2) with a sample design which permits the description of two or more resources.

16. Output. The product (goods, services, or on-site use) from forest and rangeland resources.

17. Permanent Sample. A plot or transect established and documented so as to permit repeated measurements of the same variables at the same exact places.

18. Planning Area. The area of the National Forest System covered by a Regional guide or Forest plan.

19. Precision. The clustering of sample values about their own average.

20. Renewable Resources (Resources Planning Act) Assessment. A periodic appraisal of the Nation's renewable resources.

21. Resources. The elements of supply inherent to an area within the scope of responsibilities and authorities of the Forest Service including lands, soils, timber, forage, water, air, fish and wildlife, aesthetics, recreation, wilderness, and energy and minerals. In the Forest Service, natural resources are often divided into two categories, renewable and non-renewable.

22. Resource Inventory. The collection of data for description and analysis of the status, condition, production, or quantity of resources. Inventories usually include some descriptive data, numeric data, and some means of relating that information to specific geographic locations.

23. Sampling Error. The standard error of the sample estimate, expressed either absolutely or as a percentage of the estimate.

24. Sampling Unit. A specified part (such as a prism point, line transect, fixed-area plot, or mapped unit such as a stand) of the inventory unit. Each sampling unit is regarded as individual and indivisible when the sample selection is made. Data collected from the sampling unit are expanded to the inventory unit.

25. Single-function (Resource) Inventory. An inventory describing only one component of the total resource available, such as a stand examination or a timber cruise.

26. Statistically Valid Design. An inventory design which permits the calculation of sampling error.

27. Stratification. The division of an inventory unit into subunits to improve the efficiency of the inventory and to ensure certain segments of the population are sampled.

28. Update. A method used to make inventory estimates current by manipulation of the inventory data base through accounting procedures or projection models.

08 - References

08.1 - Publications

The following publications are useful references for designing resource inventories.

08.11 - Information Needs

1. Goudarzi, Gus H. 1984. Guide to the preparation of mineral survey reports on public lands. U.S. Geol. Survey, Open-File Report 84-787.

2. Lund, H. Gyde, ed. 1984. Preparing for the 21st Century - Proceedings of the forest land inventory workshop. Denver, Colorado, March 26-30, 1984. USDA Forest Service, Timber Management Staff, Washington, DC. 334 p.

3. Pritchard, H. W., et al., eds. 1982. Resource conservation glossary. Third edition. Soil Conserv. Soc. America, Ankeny, Iowa, 1938 p.

4. Schlatterer, Ed and H. Gyde Lund, eds. 1984. Proceedings of the inventory integration workshop. Portland, Oregon, October 15-19, 1984. USDA Forest Service, Range and Timber Management Staffs, Washington, DC. 165 p.

5. USDA Forest Service. 1985. National information requirements project. Washington, DC. 140 p.

08.12 - Inventory Planning

1. Husch, B. 1978. Planning a forest inventory. FAO Forestry and Forest Products Studies No. 17. Food and Agriculture Organization of the United Nations. Rome, Italy. 121 p.

2. Lund, H. Gyde. 1986. A primer on integrating resource inventories. USDA Forest Service, Gen. Tech. Report WO-49, Washington, DC. 64 p.

08.13 - Inventory Designs and Sampling

1. Brann, Thomas B., Louis A. House, and H. Gyde Lund; eds. 1982. In-place inventories: principles and practices. Proceedings of a national workshop. Orono, Maine, August 9-14, 1981. SAF 82-02. Society of American Foresters. 1101 p.

2. Cochran, William G. 1963. Sampling techniques. Second edition. John Wiley & Sons, NY. 413 p.

3. Freese, Frank. 1962. Elementary forest sampling. USDA Forest Service, Agriculture Handbook No. 232. 91 p.

4. Freese, Frank. 1967. Elementary statistical methods for foresters. USDA Forest Service, Agriculture Handbook No. 317. 87 p.

5. Platts, William S., Walter S. Megahan, and G. Wayne Minschall. 1983. Methods for evaluating stream, riparian, and biotic conditions. USDA Forest Service, Gen. Tech. Report INT-138. Ogden, Utah. 70 p.

08.14 - Resource Measurements

1. Avery, Thomas Eugene. 1975. Natural resource measurements. McGraw-Hill Book Co., New York. 339 p.
2. Conant, Francis et al. 1983. Resource inventory and base line study methods for developing countries. American Association for the Advancement of Science. Pub. 83-3. Washington, DC. 539 p.
3. EPA, 1980. Ambient monitoring guidelines for prevention of significant deterioration. EPA - 450/4-80-012.
4. EPA, 1981. Quality assurance handbook for air pollution management systems: Volume IV Meteorological Measurements. EPA - 600/4-82-60.
5. Fox, D.G., et al., 1987. Guidelines for measuring the physical, chemical and biological indicators of wilderness ecosystems. USDA Forest Service, Gen. Tech. Rep. RM-146. Rocky Mtn. Forest & Range Exp. Stn., Ft. Collins, CO.
6. Fox, D.G., et al., 1988. A screening procedure to evaluate air pollution effects in wilderness. USDA Forest Service Gen. Tech. Rep. (In press).
7. Myers, Wayne L., and Ronald L. Shelton. 1980. Survey methods for ecosystem management. John Wiley and Sons, New York. 403 p.
8. Soil Survey Staff. 1983. National soils handbook. USDA Soil Conservation Service.
9. U.S.D.A. Forest Service. 1989. Interim Resource Inventory Glossary. Washington, DC. 96 p.

08.15 - Monitoring

1. Brown, James K. 1974. Handbook for inventorying downed woody material. USDA Forest Service Gen. Tech. Report INT-16. 24 p.
2. Bruce, David. Yield differences between research plots and managed forests. Jour. Forestry 75(1):14-17. January 1977.
3. Curtis, Robert O. 1983. Procedures for establishing and maintaining permanent plots for silvicultural and yield research. USDA Forest Service. Gen. Tech. Report PNW-155. 56 p.
4. Curtis, Robert O., and David M. Hyink. Data for growth and yield models. In: Van Hooser, Dwane D., and Nicholas Van Pelt, compilers. Proceedings--growth and yield and other mensurational tricks: a regional technical conference: 1984 November 6-7; Logan, UT. Gen.

Tech. Rep. INT-193. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station; 1985: 1-5.

5. Ek, Alan R., and Harold E. Burkhart. Silvicultural considerations in timber inventory. *Jour. Forestry* 74(7):435-437. July 1976.

6. Fitzgerald, Richard O., Nelson S. Loftus, Jr., and Carl R. Puuri. Forest growth and yield system development and implementation--national summary. USDA Forest Service, internal report, TM and TMR Staffs, Washington, DC. August 1985. 13 p.

7. Howes, S. W., J. Hazard, and J. M. Geist. 1983. Guidelines for sampling some physical conditions of surface soils. USDA Forest Service, PNW Region, R6-RWM-146, 34 p.

8. Miller, Richard E.; Hazard, John W. Strategy and tactics for monitoring long-term site productivity. In: *Proceedings, Alaska Forest Soil Productivity Workshop*. Anchorage, Alaska, April 28-30, 1987. USDA Forest Service, PNW Gen. Tech. Report 219. p. 57-62.

9. Owston, Peyton W., Mel Greenup, and Valerie A. Davis. A method for assessing the silvicultural effects of releasing young trees from competition. Gen. Tech. Rep. PWN-191. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station; 1986. 18 p.