

RESEARCH WORK UNIT DESCRIPTION Ref: FSM 4070	1. Number: RMRS-4801	2. Station: Rocky Mountain Research Station
	3. Unit Location: Ogden, UT	

4. Research Work Unit Title:
Interior West Forest Inventory and Analysis Program

5. Project Leader (Name and address):
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6. Area of Research Applicability: The eight Interior West States assigned to the Rocky Mountain Research Station, with cooperative techniques research, resource analysis, and technology transfer activities extending nationally	7. Estimated Duration: 5 years
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8. Mission:
To improve the understanding and management of our Nation's forests by measuring, assessing, and reporting on the extent, condition, and health of the forest land of the Interior West on a continuous, annual basis.

9. Justification and Problem Selection:

The Interior West States encompass over 540 million acres. Over 55 percent of the area is administered by public agencies – federal, State, and municipal. The 140 million acres of forest land in the Interior West States represent nearly one-fifth of the nation's total forest land area. Over 75 percent of this forest land area is administered by public agencies, with the National Forest Systems administering over half of all forest lands. Approximately 17 million acres of forest are set aside in proclaimed wilderness, National Parks, and other administratively reserved areas. An additional 16 million acres are currently designated as roadless. Altogether, the forests in the Interior West contain over 130 billion cubic feet of wood volume. These lands grow approximately 2.8 billion cubic feet of tree volume each year. Mortality reduces gross growth by 27 percent, and this is expected to steadily increase due to the overstocked conditions found in many forest stands in the Interior West.

Interior West forests provide a multitude of resources and amenities such as recreational opportunities for millions of visitors, fuel wood supply, grazing for domestic livestock, habitat for many species of wildlife, and protection of watersheds. However, the management of these forests is continually changing as a result of Federal land management policies, changes in forest resource demand, changes in the vegetation, increased knowledge about use opportunities and interrelationships, and changes in technology. For example, forests are at an increased risk of insect outbreaks and fires due to overstocked conditions; growing urban populations in the West have placed increased use pressure on many forests, and recent shifts in public policy have reduced timber harvest levels from the historic highs of 20 years ago. Given these factors, there is an urgent need for up-to-date forest information in order to prioritize and plan forest management strategies.

10. Approach to Problem Solution (Start at conclusion of item 9.)

Signature	Title	Date
Recommended: /s/ Jack B. Waide	Assistant Director for Research	7/21/03
/s/ W. Brad Smith	Assistant to Staff Director	7/25/03
/s/ Richard W. Guldin	Staff Director	25 July 03
Approved: /s/ John R. Toliver (for)	Station Director	8/7/03
Concurred: /s/ Robert Lewis	Deputy Chief for Research	8/25/03

As a consequence, we need to conduct continuing assessments of the extent, condition, and health of forest lands in the Interior West States (Problem 1). In addition, these assessments need to be timely in terms of (1) analyzing resource dynamics and monitoring changes over time; (2) describing resource production possibilities; and (3) evaluating the costs and consequences of alternative management and uses of resources. Such assessments contribute to decisions that provide a balance among various uses and products. Thus, it is necessary to classify and evaluate these resources to reflect use opportunities in various combinations, and it is essential to be able to evaluate with consistency the resource situation at local, State, regional, and national levels.

The Forest Inventory and Analysis Program has legislatively assigned responsibility and administrative direction for maintaining up-to-date assessments of the status and trends of forests in the Interior West. Program legislative responsibility is through the Renewable Resources Planning Act (RPA) of 1974, the National Forest Management Act (NFMA) of 1976, the Renewable Resources Research Act of 1978, the Forest Ecosystems and Atmospheric Pollution Research Act of 1988, and the Agricultural Research, Extension, and Education Reform Act of 1998 (The Farm Bill). Inclusion of National Forest System (NFS) lands was specifically assigned to FIA through a service-wide Memorandum of Understanding (01-SU-01) signed in January 2001). Administrative direction comes primarily through the FIA Blueprint for the 1990's, Vision for the Future, The Report of the Second Blue Ribbon Panel, and the 1998 FIA Strategic Plan.

Consequently, this Program is responsible for collection of data on all forests in the Interior West, including the National Forest System, and for providing technical coordination for monitoring and analyses at local, State, and regional levels. This involves addressing dynamic changes in information needs, not only for traditional timber data, but also for the non-market and nontraditional values within the timber base and for arid forests such as pinyon-juniper. To adequately sample and analyze these dynamics, there is a need to develop innovative methods for sampling and integrating inventory data with remotely sensed information to improve the quality and efficiency of inventory analysis and reporting products, and develop new products to meet changing customer needs (Problem 2). The Program must participate in national evaluations of resources supply and demand; conduct research to improve data collection, monitoring, and analysis methods; and maintain a database of up-to-date statistics so that resource information can be provided to the Forest Service, its cooperators, other public agencies, and the public at large.

Recently, there has been considerable interest expressed in the condition of the Nation's rangeland resources. As stated in the 2000 RPA Assessment, little information is available to identify indicators for assessing changes in rangeland ecological processes at a broad scale. The Forest Service, Bureau of Land Management, and the Natural Resources Conservation Service have attempted to develop processes for measuring range health. The Forest Service Intermountain Region has undertaken an inventory of the Bridger-Teton National Forest range area with the expressed intent of developing criteria for assessing properly functioning condition. Therefore, there is a need to develop methods and procedures to test and evaluate indicators for assessing rangeland status and health (Problem 3).

10. Approach To Problem Solution:

All work conducted under this RWUD will conform to the requirements of the Food Security Act (7 U.S.C. 2276, as amended) and will adhere to the terms of the directive of FIA Data Privacy and Release.

Problem 1 – Conduct continuing assessments of the extent, condition, and health of forest lands in the Interior West States.

Assessments involve examining the current situation and monitoring and evaluating the dynamics of change that created today's forests and the role these dynamics may play in shaping the forests of the future. Assessments encompass all resources related to forests. Therefore, the approach to a solution of Problem 1 will include studies designed to provide analyses and interpretations of current forest resource situations and trends within Interior West States, and to address specific problems peculiar to each State or sub-region of interest. Results will identify additional renewable forest resource-related research areas, opportunities for improved management of resources, and potential conflicts among resource uses.

To facilitate a systematic research program, the problem will be divided into four major elements, as follows:

Element A -- Implement the annual inventory process in the Interior West

The research title to the 1998 Farm Bill provides clear direction on what is to be done with regard to the annual inventory process. FIA is directed to:

1. Develop a Strategic plan for implementing annual inventories, including the development of a standard core program of data collection and compilation outputs;
2. Have updated compilations of the annual data no later than 6 months after the last plot in the current annual panel has been taken;
3. Develop analytical reports for each State at the conclusion of data collection on the fifth panel. These reports are to include an analysis of the findings from the current effort as well as a 20-year look back to assess major trends in resource dynamics.
4. Merge the Detection Monitoring phase of the Forest Health Monitoring Program into the enhanced FIA program;
5. Increase our use of advances in technology (see Problem 2); and
6. Do all of the above in close collaboration with our partners, especially the State Foresters and our National Forest System counterparts.

All inventories conducted in the Interior West will be transitioned to an annual approach. There are still States (Wyoming, Colorado, Idaho, and Montana) where baseline data are out of date. These States' inventories, where possible, will be designed to bring the resource information to a current status by measuring all or part of the annual panels within a given timeframe so that the Strategic Plan target of being annual everywhere can be achieved as soon as funding is available to do so.

The inventories will be conducted as a three-phase system. Phase I will involve the acquisition of remotely sensed data to improve the precision of population estimates through stratification. This information may come from a variety of sources, including products derived from TM, AVHRR, DEMs, and MODIS, to name a few. Cooperation with RSAC, Geospatial Service and Technology Center, USGS Eros Data Center, and others may lead to more efficient acquisition and use of ancillary data, and will keep the Program informed of new and potentially useful products.

Phase II of the inventories will include implementation of the standard national core field data collection manual with regional add-ons, as well as the migration to the national hexagonal grid. The national manual calls for collecting data using a fixed-area sample that differentiates unique conditions on the ground by mapping them based on specific criteria such as stand density, ownership, and forest type. The variables to be sampled are designed to provide a comprehensive look at plot-, condition-, and tree-level attributes. The hexagonal grid is a variant of the grid adopted by the Forest Health Monitoring Program and is based on a design developed by the Environmental Protection Agency's Ecosystem Monitoring and Assessment Program (Scott CT, Cassell DL, Hazard JW. 1993. Sampling design of the U.S. National Forest Health Monitoring Program). The grid is designed to provide a sampling intensity of one field plot per 5,929 acres.

Phase III of the inventories is a systematic subset of the Phase II grid and is designed to be spatially less intense than the Phase II sample. The Phase III grid represents approximately 95,000-acres/plot at full implementation; however, only 1/5 of the plots are taken per year. Thus, the annual sampling intensity equals one-plot/475,000 acres. The data measured on the Phase III plots is more comprehensive than that collected on the Phase II plots. The attributes measured at each sample location are intended to provide early detection of emerging forest health symptoms and include crown assessment variables such as dieback, density, and foliar transparency; soils, both physical properties and chemical composition; lichen richness and abundance; down woody debris; understory vegetation richness and diversity; and to some extent, ozone damage.

Underlying all three phases of the inventory process is a standardized quality assurance/quality control (QA/QC) program, based on the three tiers of 1) prevention, 2) assessment and appraisal, and 3) correction. The QA system will be implemented through a series of real time audits to assess where more training is needed, assess how crews are performing, and assess true data quality through a series of blind checks.

Planned accomplishments for the next 5 years include:

1. Work in the following States:

Baseline refreshing inventories

<u>State</u>	<u>Year</u>	<u>Comments</u>
Wyoming	2003	Baseline
Idaho	2003	R1 NFS
Montana	2003	Baseline on the non-NFS lands

Annual inventories

<u>State</u>	<u>Year to Start</u>
Utah	2000
Arizona	2001
Colorado	2002
New Mexico	2004
Nevada	2004
Idaho	2003
Montana	2003
Wyoming	2004

2. Cooperative inventories with other Federal agencies:

- a. All federal lands are now covered under the annual inventory process.
- b. Conduct special data collection efforts and studies for rapid assessments (e.g., large-scale fires).

Element B -- Conduct regional, State, and NFS analyses and reports, and conduct specific natural resource issue-driven analyses

The interaction of the forest ecosystems and socio-economic forces in the Interior West results in an ever-changing array of natural resource issues and questions that range from local to national in scope. Legislators and resource planners and managers at all levels rely on NFS, State, regional, and national assessments and analyses for input in making critical decisions affecting the economic and environmental well-being of all citizens of the region. Due to the long-term nature of forestry investments and commitments, it is imperative that information for these decisions be timely and accurate.

Planned accomplishments for the next 5 years include:

1. Preparation and publication of baseline analytical reports on the forest resource situation in Arizona, New Mexico, and Wyoming based on periodic inventories.
2. Produce statistical tables and figures of results and on-line data access for States inventoried on an annual basis; data for these States will be compiled and released as appropriate according to national policy, but generally within six months after the current annual panel is completed.
3. Publish analytical reports every 5 years for States involved in the annual inventories; Utah and Arizona will be the only States for which 5 panels of annual-system data will be collected during the period covered by this Charter.
4. State-level analyses of the primary timber products industry and associated trends in timber utilization as part of the 5 year reporting process in cooperation with the University of Montana. Reports will include:
 - a. State-level industry analysis
 - b. Removals from inventory
 - c. Resources Planning Act Assessment and Timber Products Output (TPO) database
 - d. Other related projects

5. Preparation of information needed for compilation of the GPRA National Update and Reassessment, and the 2003 Sustainability Report.

6. Preparation of National Forest Reports.

Element C -- Evaluate Resource Dynamics

Studies under this element will be designed to analyze the components of change (growth, mortality, and harvest, as well as shifts in land use and ownership patterns) and their effect on the resource base. These analyses will include an evaluation of past trends and the effect of their continuation into the future.

Additional studies will be designed to provide information that can be used to make recommendations on how to mitigate adverse effects such as severe over cutting in certain ownerships, species, and/or diameter classes, and large-scale disturbance events such as fires, blow downs, etc.

Planned accomplishments for the next 5 years include:

1. In-depth analyses of the dynamics of change from re-measurement inventories.
2. Conducting studies to develop utilization factors that reflect current harvest methods that can be used to relate harvest estimates to standing inventory.
3. Analysis of the damage and insect and disease incidence data that have been collected over the last cycle and are now being re-measured. These data may provide the basis for improved mortality modeling.
4. Continuing to work collaboratively to assess fire effects and damage, invasive weed spread after fire, and post-fire infestation by insects.

Element D -- Expand Analysis of Other Forest Resources

Under this element, research studies will feature the identification of non-commodity resource values in forest ecosystems, their potential impact on management decisions, and their interactions. Special emphasis will be given to the evaluation of habitat requirements of threatened and endangered species, biodiversity, carbon, biomass, fuels, other Criteria and Indicators of sustainability, roadless areas, extent of Interior West old-growth, and analysis of resource interactions.

Planned accomplishments for the next 5 years include:

1. Development of guidelines and data screening techniques for quantifying area of potential suitable habitat for wildlife including threatened and endangered species such as the Mexican Spotted Owl and Lynx.
2. Identification of habitat requirements for wildlife that may be compatible with timber stand treatment alternatives, and analysis of stand treatment options for enhancing wildlife habitat.
3. Analysis of forest fragmentation to identify urban/forest interface areas and identify areas of increased risk of wildfire impacts and insect and disease outbreaks.
4. Analysis of total vegetation community for carbon sink and biomass potential.
5. Refine methods to evaluate non-commodity resource attributes; develop analytical methods to aid in evaluating wildlife habitat conditions and extent; develop closer alliance with a diverse group of multi-resource data users.

The beneficiaries of the research, analysis, and reporting include a diverse set of users, such as:

- The public in general,
- Land managers,
- Resource analysts,
- Research scientists, and
- Others who need to use resource statistics in their research, including public and private resource planners, managers, forest industry and recreation professionals, regional planners, natural resource investigators, and economists.

The potential benefits of this research are current, comprehensive, and reliable resource statistics, summary reports, and analyses that are necessary for the development and implementation of programs and policies to improve the quantity, quality, and services from the forest resources of the Interior West.

The nature of this research is such that a reasonably high level of success can be expected. The Program's outputs will provide land managers and resource analysts with current forest resource data and improved techniques for managing and evaluating the forest resources of the region.

Environmental considerations: The work planned involves inventory and research activities which are clearly limited in context and intensity, and as such are categorically excluded from environmental analysis requirements (FSH 1909.15, Chapter 30, Section 31.1a(3)).

Problem 2 -- Develop innovative methods for sampling and integrating inventory data with remotely sensed information to improve the quality and efficiency of inventory analysis and reporting products, and develop new products to meet changing customer needs.

Land managers, private industry, and the public in the Interior West are placing higher demands on forest inventory information. They need more timely estimates of forest population totals that are unbiased and precise and are calling for maps depicting the spatial distribution of forest attributes, as well as a means to integrate inventory information with their numerous GIS layers. Maps of key forest inventory variables of known quality over large geographic areas would greatly enhance forest land managers' ability to identify suitable wildlife habitat, assess resource loss to catastrophic events, evaluate management prescription alternatives, and many other analyses. In addition, there is a wealth of information hidden in the vast quantities of inventory and ancillary digital data sources. Improved forest resource estimates and automated and visual analysis tools would not only enhance FIA analysts' ability to report on resource dynamics, but give customers the ability to explore relationships affecting the lands they manage.

Recent advances in the fields of remote sensing, statistics, and computer science afford FIA the opportunity to both improve the efficiency of our annual inventory products and expand our product line to include maps and dynamic analyses. Over the next 5 years, studies under this problem will result in the following:

- Improved sampling methods for resource inventory design and measurements
- More efficient means to quantify population totals within an annual data collection system
- New FIA map products of known quality and utility
- Automated data extraction, visualization, and analysis capabilities

Specific studies will be conducted in partnership with scientists at Utah State University, USGS Biological Resources Division, Iowa State University, Colorado State University, USFS Remote Sensing Applications Center, and other RMRS scientists. Targeted for completion in the next 5 years include studies to:

1. Evaluate use of low altitude photography and fine resolution imagery for supplementing field samples, particularly in inaccessible areas.
2. Develop prediction models for updating stand data and "non-visited" plots using extensive re-measurement data.
3. Improve precision in forest inventory estimates by exploring cost-effective alternatives for stratification of field plots, including TM and MODIS based information.
4. Develop nonparametric model-assisted survey estimation techniques to maximize information from ancillary data.
5. Automate stratification procedures to streamline compilation of field data.
6. Modify area control process to minimize effects of erroneous area targets and maximize variance reduction through stratification.
7. Develop standards and visual evaluation criteria for spatial FIA products to insure FIA-produced maps are of known accuracy and utility for management applications.

8. Develop and distribute consistent sets of ecoregion-level maps of key forest inventory variables in the Interior West.
9. Compare nonlinear and nonparametric modeling techniques for predicting forest inventory variables using ancillary data.
10. Build and test large-scale models predicting presence of cavity nesting birds and elk calving sites on the Fishlake National Forest.
11. Test applicability of FIA-generated maps as core data layers in pilot tests on selected National Forests.
12. Develop a system for distributing forest inventory map products using CD-ROM and the Internet.
13. Evaluate MODIS imagery and FIA products for regional-scale burn area mapping.
14. Develop an automated data extraction, graphical display and exploration system for analysis of forest inventory data coupled with digital ancillary data within a GIS environment.

The beneficiaries of the research include a diverse set of users, such as:

- Natural resource managers needing current estimates and maps of resource variables across broad geographic areas for planning.
- Resource analysts trying to systematically and visually extract more information from large quantities of plot data and digital ancillary layers.
- Wildlife biologists trying to identify suitable wildlife habitat.
- Survey statisticians seeking more cost effective methods for producing precise population estimates and detecting change.
- Ecological modelers needing methodology for predicting ecological characteristics in space.
- Forest inventory managers seeking to reduce production costs.

The potential benefits of this research are current, comprehensive, and reliable resource statistics and spatial information that are necessary for the development and implementation of programs and policies to improve the quantity, quality, and services from the forest resources of the Interior West.

The nature of this research is such that a reasonably high level of success can be expected. The Program's outputs will provide land managers and resource analysts with improved estimates (increased precision and lower costs), more spatially explicit information, and techniques for managing and evaluating the forest resources of the region.

Environmental considerations: The work planned involves inventory and research activities which are clearly limited in context and intensity, and as such are categorically excluded from environmental analysis requirements (FSH 1909.15, Chapter 30, Section 31.1a(3)).

Problem 3 -- Develop methods and procedures to test and evaluate indicators for assessing rangeland status and health.

There is an emerging need to develop databases similar to the FIADB for rangelands. It has been estimated that there are in excess of one billion acres of rangeland in the United States and most is concentrated in the West. There is little, if any, consistent information available on rangelands to describe their extent or health. There are some data available about various allotments, but nothing that can be extended to provide comprehensive and consistent information about the resource. Some past efforts have attempted to develop indicators of range health, but they have always met with difficulty where landscape level analyses were needed. In the Interior West, collaborative efforts have been initiated to develop and pilot test one approach based on Proper Functioning Condition to assess rangeland health at the National scale, and these efforts are yielding promising results. Over the next 5 years, research on this problem is designed to provide a mechanism to further assist in the development of indicators of rangeland health and development of strategies for conducting large-scale analyses of rangeland extent, composition, and to monitor trends.

Outputs may include:

1. Publication of the results of the Bridger-Teton National Forest Range Pilot in an RMRS GTR - "Indicators of Rangeland Health and Functionality in the Intermountain West."
2. Further collaboration with the Intermountain Region on the development/refinement of criteria for the Physically Functioning Condition concept.
3. Extending our current work into all NFS rangeland (non-forest) conditions in the Interior West.

11. Staffing:

The research and other activities outlined in this document will require the following staffing. This does not include positions or budget for national FIA positions funded through the WO FIA.

Distribution of scientist years through the 5-year term is as follows:

<u>Problem Area</u>	Staff Years				
	<u>2003</u>	<u>2004</u>	<u>2005</u>	<u>2006</u>	<u>2007</u>
1					
Scientist	0.2	1.2	1.2	1.2	1.2
Professional					
- Data Coll.	49.0	57.5	57.5	57.5	57.5
- Analysis	4.8	4.8	4.5	4.5	4.5
- Info Mgt	11.0	11.0	11.0	11.0	11.0
Administrative	9.0	11.2	11.2	11.2	11.2
Technician	23.0	33.5	33.5	33.5	33.5
Cooperators	4.0	4.0	4.0	4.0	4.0
2					
Scientist	0.8	1.8	1.8	1.8	1.8
Professional					
- Data Coll.					
- Analysis	2.0	3.0	3.0	3.0	3.0
- Info Mgt	1.0	2.0	2.0	2.0	2.0
Cooperators	2.0	3.5	3.5	3.5	3.5
3					
Professional					
- Data Coll.					
- Analysis	0.2	0.2	0.5	0.5	0.5
- Info Mgt					
Totals	107.0	132.5	132.5	132.5	132.5

The annual budget requirement for this program of work is (including overhead):

- FY 2003 -- 11.5 million
- FY 2004 -- 14.9 million
- FY 2005 -- 15.5 million
- FY 2006 -- 16.2 million
- FY 2007 -- 16.8 million