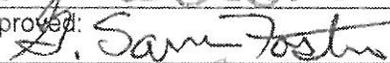


RESEARCH WORK UNIT DESCRIPTION Ref: FSM 4070	1. Number RMRS-4801	2. Station Rocky Mountain Research Station
	3. Unit Location Ogden, UT, Portland, OR, Fort Collins, CO Bozeman, MT, Whitefish, MT, Tucson, AZ Prescott, AZ, Missoula, MT, Gunnison, CO Madison, WI, Driggs, ID,	
4. Research Work Unit Title Inventory and Monitoring Science Program (includes FIA)		
5. Program Manager (Name and address) Michael J. Wilson, U.S. Forest Service, Forestry Sciences Laboratory, 507 25 th Street, Ogden, UT 84401		
6. Area of Research Applicability Multiregional		7. Estimated Duration 10 years
8. Mission To improve the understanding and management of the forest and rangelands in the Rocky Mountain States by providing resource inventory and monitoring information, and by providing analysis and tools needed to effectively identify current status and trends, management options and impacts, and the risk and effects of fire, insects, disease, climate change, and other natural and man-caused processes to guide effective planning, management, and policy.		

9. Justification and Problem Selection

Description

The 12 States within the Rocky Mountain territory encompass over 740 million acres. These lands provide a multitude of resources and amenities such as recreational opportunities for millions of visitors, wood fiber and fuel wood supply, grazing for domestic livestock, habitat for many species of wildlife, and protection of watersheds. However, the management of these lands is continually changing as a result of Federal land management policies, changes in public use of forest and rangelands, changes in climate, changes in the vegetation conditions, increased knowledge about use opportunities and interrelationships, and changes in technology. For example, forests

Signature	Title	Date
Recommended: 	Program Manager	11-10-08
	WO National Program Leader/WO Inventory and Monitoring SPA Leader	12-9-08
	WO Staff Director	9 DEC 08
Approved: 	Station Director	12/19/08
Concurred: 	Deputy Chief for Research & Development	1/6/09

are at an increased risk of insect outbreaks and fires due to recent severe droughts and overstocked conditions; growing urban populations in the West have changed how the public uses these forests; and recent shifts in public policy have reduced timber harvest levels from the historic highs of twenty years ago. Given these factors, there is an urgent need for up-to-date vegetation information in order to prioritize and plan public policy, investments by the private sector, and forest and rangeland management strategies.

The Station's Forest Inventory and Analysis Program (FIA), a major component of the Inventory and Monitoring Science Program, is responsible for the Forest Service's national strategic forest inventories for the eight Interior West States (Figure 1) comprising over 540 million total acres.



Figure 1. Rocky Mountain Research Station States with Interior West FIA States (shaded). The Northern Research Station FIA Program administers the Plain States, and the Southern Research Station FIA Program Administers Texas and Oklahoma.

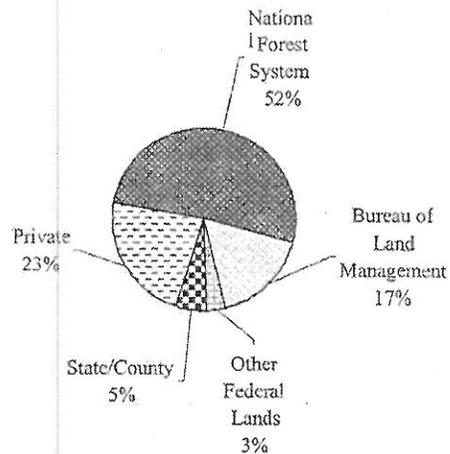


Figure 2. Distribution of Forest Land by owner.

The 145 million acres of forest land in the Interior West States represent nearly one-fifth of the nation's total forest land area, and more than half this land is administered by the National Forest System. Approximately 17 million acres of forest are set aside in proclaimed Wilderness, National Parks, and other areas administratively reserved from timber utilization; and an additional 16 million acres are currently designated as Roadless areas.

Issues

Because the conditions of the forest and rangelands are so closely tied to the populace, the need to continually quantify what is there (inventory) and track what is happening to those resources (monitor) was recognized early on and formalized in 1928 with the passage of the McSweeney-McNary Forest Research Act (P.L. 70-466). This Act directed the Secretary of Agriculture to make a comprehensive survey of the present and prospective requirements for timber and other forest products of the United States. Over the next 75 years various laws augmented and modified this initiating legislation to keep the inventory of this important and dynamic forest resource relevant to the needs of the day. The Forest and Rangeland Renewable Resources Planning Act (RPA) of 1974 (P.L. 93-378) and 1978 (P.L. 95-307) broadened the scope of the original Act to include a more comprehensive inventory and analysis of the forest and range lands of the United States. In 1988, a section of the Forest Ecosystems and Atmospheric Pollution Research Act (P.L. 100-521) provided direction for the long-term monitoring of forest health. More recently the Agriculture Research, Extension, and Education Reform Act of 1998 (16 USC 1642(e)) called for annual forest inventories, and an amendment to Section 1770 of the Food Security Act of 1985 (7 U.S.C. 2276(d)) in the Fiscal Year 2000 Consolidated Appropriations Bill (PL 106-113) added FIA data collection to a list of items requiring confidential treatment. Federal appropriated funds for FIA has increased over 3-fold during the past 10 years in response to public demand for FIA data. For all of these reasons, the FIA Program has legislatively assigned responsibility and administrative direction, with strong support from very diverse publics, for maintaining up-to-date assessments of the status and trends of the nation's forests.

Nationally, the IM Program is part of both the Forest Service Research and Development Inventory and Monitoring Science Program Area (SPA) and the Forest Inventory and Analysis (FIA) national Program. As such, the Program receives significant direction from the Forest Service Strategic Plan, 2007-2012, and from the FIA Strategic Plan (2007).

The IM Program addresses several Agency goals as stated in the ***Forest Service Strategic Plan*** :

- Provide science and technology to restore, sustain, and enhance the nation's forests and grasslands by developing methods and tools to continuously monitor the nation's forests, range, and grasslands.
- Provide science and technology to sustain and enhance benefits to the American people by quantifying ecosystem services provided by our nation's forests, range, and grasslands.
- Provide science and technology to improve organizational excellence and effectiveness by continuously monitoring the status and trends of our nation's forests, range, and grasslands.
- Provide science and technology to sustain and enhance environmental quality and services in urban and urbanizing landscapes by establishing an urban monitoring program.

The IM Program addresses several goals and objectives described in the national *FIA Strategic Plan* (2007). The legislation passed by Congress in 1998 envisioned an FIA program that is a strong partnership between State organizations and the USDA Forest Service and provided a Base Federal Program comprising:

- A three-phase program including remote sensing (Phase 1), a sample of ground plots measured for basic forest data (Phase 2), and a much smaller sub-sample of the Phase 2 sample plots measured in much more detail for an extended suite of ecosystem attributes (Phase 3);
- Annual data collection on 10% of all Phase 2 plots in the western U.S.¹;
- A consistent core set of field measurements collected across all forested lands and all land ownerships²;
- A National Woodland Owner Survey (NWOS) to increase our understanding of private forest and woodland owners;
- A survey of timber products output for each State;
- Compilation of all field data on an annual basis, made available online within 6 months of the end of the data collection for the panel;
- Comprehensive, analytical reports at 5-year intervals for each State.

Consequently, the IM Program is responsible for collection of data on all forests lands in the Interior West, including the National Forest System lands, and for providing tools and technical coordination for monitoring and analyses at local, State, and regional levels. Therefore, it is critical to conduct annual strategic inventory and monitoring, and periodic assessments of the extent, condition, and health of forest lands in the Interior West States (Function 1). This is the highest priority function for the Inventory and Monitoring Program and is critical for Federal, State and private land managers and policy-makers.

In addition, the FIA Strategic Plan encourages the Program to expand its scope in several areas:

- Research and development to improve how data are collected, compiled, analyzed, and disseminated. This includes research to improve efficiency, sampling and estimation accuracy, more precise small-area assessments, improved geospatial analytical tools, and enhanced mechanisms for making the data and results available to the public;
- Increase use of remote sensing and spatial analysis techniques;

¹ The Agriculture Research, Extension, and Education Reform Act of 1998 (16 USC 1642(e)) called for annual forest inventories that remeasured 20% of all FIA plots every year. To remain within available funding, the FIA strategy has been to remeasure 10% of all FIA plots every year in the western USA. In 1999, this strategy was proposed to Congress, and Congress had no objections to the proposal.

² Amendment to Section 1770 of the Food Security Act of 1985 (7 U.S.C. 2276(d)) in the Fiscal Year 2000 Consolidated Appropriations Bill (PL 106-113) added FIA data collection to a list of items requiring confidential treatment, which strictly protects private property rights and privacy of federal data collected from private individuals.

- Improve land use and land cover change analysis;
- Enhance support for NFS planning, monitoring, and other business needs;
- Development of rapid assessment tools and support for assessing small and large scale disturbances such as fire, storms, and insect outbreaks;
- Development and implementation of an urban forest inventory;
- Development of a strategic level integrated rangeland inventory, both to network with other Agency strategic scale inventories (such as the National Resources Inventory conducted by USDA Natural Resource Conservation Service) and to support the National Forest System and Bureau of Land Management landscape planning and monitoring needs;
- Evaluate enhancements to the FIA sample design and measures to capture important wildlife habitat components and improve the use of FIA data and maps for wildlife habitat evaluation

Other significant national needs for a strategic scale inventory and monitoring of the terrestrial vegetation resources in the U.S. include carbon reporting and trading, quantification of ecosystem goods, services and functions, and global climate change research and policy analyses. Although the development and implementation of all these opportunities are not included in the current work, the IM Program can provide leadership to pursue these through research and development, strategic partnerships, and cost sharing with other programs.

Regionally, understanding the status and trends of the Interior West forests and rangelands is an essential public mission, considering the large diversity of public agencies and private landowners, extreme vegetation diversity across the Rocky Mountain States, and the changing dynamics of resource condition, use, and public preferences. In the Interior West States, there are 48 National Forests within four NFS Regions, eight BLM management districts, and approximately 40 National Parks. There are also numerous wildlife refuges, thousands of private landowners, and a variety of industrial land owners. As well, the Interior West boasts some of the most diverse range ecosystems, spanning the Southwest deserts, the Colorado Plateau and Great Basin woodland and rangelands, the central and northern Rocky Mountains timberlands and alpine forests. In fact, the extent of woodland and rangelands far exceeds the extent of forestlands within the Interior West, and there is no nationally consistent inventory and monitoring program in place for the nation's public rangelands (NRI has limited information on private rangelands, but no information on public rangelands).

As described in the *Rocky Mountain Research Station's Strategic Framework (2003)*, several factors necessitate current foundational information on the status and trends of the forests and rangelands in the Interior West. Growing human populations are increasing the use of forests, deserts, and grasslands (wildlands), and the corresponding urbanization impacts of the wildland-urban interface are leading to higher risks to these natural resources. These changes are occurring at a rapidly increasing pace. Increases in the standing vegetation density and fuel loads and effects of recent severe drought in the West are

having significant impacts on insect outbreaks, tree mortality, the spread of invasive plants, insects and diseases, all leading to increasing risks to ecosystems health and productivity. Concerns over wildlife and fish conservation have lead to major policy shifts and litigation related to wildlife habitat, such as old-growth forest, which is directly linked to the vegetation structure and composition used as food and shelter.

With the strong national and regional direction for the IM Program, it is evident that policy makers, public agencies, private industry, researchers, and the public rely on strategic scale vegetation information. The information helps policy makers at the State and federal level formulate good resource policy and assess the sustainability of current and past policy. Public agencies are better able to devise plans and management activities, assess the effects of current and past management practices, and forecast future conditions with accurate and current vegetation inventory and monitoring data. Private industry uses the information to assess opportunities for economic development. Scientists use the information as a baseline for scientific investigations as for extending research findings to the landscape scale. And the public is kept informed about the health and sustainability of the nation's forest and rangelands.

Therefore, a wide variety of research is required to address both the local and national needs for inventory and monitoring information (Function 2). To address the growing needs for and yet increasing costs of conducting inventory and monitoring, the IM Program must continue research to improve efficiencies in inventory and monitoring functions using remote sensing, sampling, and estimation techniques. To support the increasing demands placed on land management practitioners and changing client needs for information, it is critical that the IM Program develop tools and techniques to support innovative applications of strategic vegetation information for changing needs of land management planning, monitoring, adaptive management, and research. Likewise, tools are needed for Regional and national sustainable forestry monitoring and reporting. Research is needed in using remote sensing technologies and statistics to provide mapping tools, spatial depictions (e.g., maps), and estimates of vegetation resources at multiple spatial and temporal scales and to quantify disturbance effects and characterize impacts on vegetation and other resources (wildlife, water, etc.). And finally, Regional science leadership is needed in assessment and monitoring of climate-change research-critical data such as forest biomass and carbon dynamic.

Because of the increasing demand for FIA and other inventory and monitoring data, it is essential that the IM Program facilitate the use of the strategic-scale framework and data for special information requests, implementation of new applications and tools, leveraging cooperative inventories, integrated resource analyses, and extension of research findings across scales and ecosystems **(Function 3)**.

10. Approach to Problem Solution

In order to effectively provide the necessary information to address these critical resource issues and to support the national and regional direction given to this Program, the Inventory and Monitoring Science Program comprises three primary functions:

Function 1: Strategic Inventory, Monitoring, and Analysis – Conduct annual strategic inventory and monitoring, and periodic assessments of the extent, condition, and health of forest lands in the Interior West States.

The IM Program tracks and analyzes trends of national core indicators of health and sustainability and provides synthesized reports to international, national and local policy makers, land managers, and investors so they can make informed decisions based on scientifically credible information. This Program provides current and annually updated data and analyses on the status and trends of forest resources directly to the National Resource Planning Act assessments, the Heinz Center State of the Nation's Ecosystems project, and Global Forest Resource Assessment conducted by the Food and Agricultural Organization of the United Nations.

As authorized by law, 10 percent¹ of the strategic forest inventory sample plots (FIA) in each State in the West are measured each year; the data and any analyses are made available annually; a core national set of measurements is used with regionally developed add-on measurements across all forestlands and all ownerships; annual data are posted on the FIA public web site each year; State-level analytical reports are focused on key resource issues and produced every five years; and permission to collect data is obtained and privacy of those individuals supplying the data is protected.

This function covers all aspects of gathering, processing, and reporting annual inventory data. The efficiency of this function must be continuously improved to be conducted within available funding and meet the annual deadlines for delivering privacy-protected inventory data and the required five-year State reports. Objectives of this function include:

- A. Conduct the annual inventory in all eight Interior West States each year. It is necessary that the IM Program fully implement the FIA annual inventory to collect and report on the mandated basic vegetation and site information on forest lands. The annual inventory is currently implemented in 5 of the Interior West States and an additional 4 Rocky Mountain territory Plain States, but the increasing demand for complete coverage necessitates a fully

- implemented program. The Program must continue focusing data collection efforts on the core elemental/foundational information on site and vegetation to answer current and future questions. This includes data collection and analysis for Timber Product Output (TPO) reporting.
- B. Provide an annual data release for all States, six months from the date of last field plot.
 - C. Publish State 5-year analytical issue-focused reports. These 5-year Statewide assessments must be timely in terms of analyzing resource dynamics and monitoring changes over time, identifying significant and emerging issues and trends, describing resource production possibilities, and evaluating the 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.
 - D. Improve field data collection efficiencies (decreasing cost/plot) through effective use of duty stations, improved field data collection efficiency techniques, increased use of technology to improve plot access and data collection, contracting, and others.
 - E. In addition, the IM Program, in collaboration with other Forest Service Deputy Areas, and other federal and State agencies, must continue to explore and expand opportunities to include the nonforest vegetation landscapes such as deserts, grasslands, and shrublands, as well as urban forests, in an inventory and monitoring framework. Vegetation information across all landscapes, including those with little or no tree cover, is essential to provide managers and policy-makers with full information on biomass and carbon, watershed condition, wildlife habitat and fire risk, and others Cooperative all-condition inventories on National Forest lands and multi-phased approaches to inventory and monitoring, such as the Program's Nevada photo-based pilot, may provide the resources and low cost techniques to obtaining that information outside the current FIA mandate.
 - E. As part of the national Inventory and Monitoring Science Program Area and the FIA national Program, the IM Program must continue to contribute to national inventory and monitoring bands, task teams, and other work groups. This effort includes all production and research staff areas within the Program to continue effective enhancement of data collection operations in terms of consistency, productivity, quality, and safety; relevant data analyses, and effective client support.

Function 2: Inventory and Monitoring Techniques Research and

Development – 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, to support land management planning and monitoring needs, to quantify disturbance effects on various resources, to broaden the scope of strategic vegetation inventory applications, and to develop new products to meet changing customer needs. The planned research included in this Function can be aggregated into several goals, or Focus Areas, as follows:

- A. Improve efficiencies in inventory and monitoring. Research to improve efficiencies in inventory and monitoring functions using remote sensing, sampling, and estimation techniques will improve the strategies for inventory and monitoring to compensate for the increasing cost of field data collection with the annual inventory and the demand for statistically valid current vegetation information.

A more aggressive development of remote sensing approaches is needed to improve data quality and cost effectiveness of data collection without degrading the ground-based information essential to land managers. A shift towards more remotely sensed observations is compelling in the Interior West States which have generally lower levels of forest cover and productivity, increasing costs of field data collection, and often extremely remote and hazardous conditions throughout the Rocky Mountains. While verification of remote sensing with ground data remains essential, alternatives to the current annualized panel system, in which 10% of all FIA plots are re-measured in the field each year, will be explored. Remotely sensed data from multiple sensors, along with new and more efficient statistical methods, must be sufficient to provide annual updates to the information with less intensive collection of field data. In addition, development of multi-phased or multi-stage inventory approaches using (current and new) remote sensing platforms in combination with field data may provide the strategic scale information required by many. Numerous satellite platforms could be further explored such as Moderate Resolution Imaging Spectro-radiometer (MODIS), light detection and ranging technology (LIDAR), LANDSAT imagery, low-altitude imagery, and others. The higher resolution remotely sensed data are more expensive. To control costs, statistical approaches will be developed that use a sample of higher-resolution data, rather than full wall-to-wall coverage with such remotely sensed data. These alternatives will be evaluated to ensure they continue to provide the appropriate level of ground-level detail required by land managers.

- B. Develop mapping tools, spatial depictions, and multiscale estimates. Research in using/developing remote sensing technologies and statistics will provide enhanced mapping tools, spatial depictions, and multiscale estimates of vegetation resources (multiple spatial and temporal scales).

Inventory data collected by FIA have traditionally been used to produce estimates of forest population totals over large geographic areas. However, there is an increasing need to accompany these estimates with spatial depictions of forest attributes. The research in this Focus Area will lead to production of regional maps of forest characteristics that will make these extensive forest resource data more accessible and useful to a larger and more diverse audience. Important applications of such geospatial databases include broad-scale mapping and assessment of wildlife habitat; documenting forest resources affected by fire, fragmentation, and urbanization; identifying land suitable for timber production; and locating areas at high risk for plant invasions, or insect or disease outbreaks. However, protecting the privacy of specific ground data for individual private land owners will be maintained. This research will satisfy the need to produce and distribute geospatial data of forest attributes and complement the inventory data.

- C. Develop applications for planning, monitoring, adaptive management, and research. Development of tools and techniques to support innovative applications of strategic vegetation information is necessary to address the changing needs of land management planning, monitoring, adaptive management, and other research.

Extant inventory data have potential for use in a wide variety of applications beyond traditional inventory and monitoring reporting of forest resources. For example, tools are needed to link vegetation information to other resources such as fire, wildlife, recreation, range, water and air, or to quantify the impact of climate change and climate variability on ecosystems in support of national assessments. Research in this Focus Area will improve the capability of FIA to continually improve new data collection, compilation/estimation, and analyses tools that will provide a fuller range of information to a diverse set of users. Tools will encompass a wider array of indicators of resource conditions and health, include the full range of the landscapes, be temporally up to date, and be applicable to a variety of multiple resources.

Climate Change. Understanding the current and potential effects of climate change on vegetation resources is critical for determining the associated effects on watershed health, wildlife habitat, fire risk, invasive species spread, etc. Managers and policy-makers need to understand both the current the large-scale conditions and the potential impacts in order to effectively plan for the future. Methods are needed to quantify and monitor the impact of climate change and climate variability on vegetation resources.

Ecoregion analyses. Understanding the origins of natural ecosystem patterns is essential for scientists and managers to assess the connections between action at one scale and effect at another, the spatial transferability of data and models, and the links between terrestrial and aquatic systems. Improving the information about the geographic patterns in ecosystems

facilitates improved design sampling networks and more effective analysis of ecosystem diversity.

This research and applications will include the development of strategic scale inventory and monitoring techniques where no complete framework currently exists; for example

- Techniques for sampling consistently across all vegetation types (remote sensing and/or ground sampling) such as techniques for rangeland inventory and monitoring that integrate with forest inventory.
- Annual monitoring tools for species mortality, the spread of invasives plant species, changes in forest distribution, etc;
- Techniques for developing and supporting a national rangeland inventory.

This research also includes:

- Techniques for integrating the FIA inventory information with the ongoing changes in the landscape due to small and large scale management activities and disturbances.
- Leveraging existing data (FIA, other sources) for wider applications to provide robust inventory and monitoring information for other issues/resources such as wildlife and fuels. Developing wider applications of FIA data, such as the recent Fuels Synthesis program that used FIA data as the seed for starting the analysis.
- Developing methods and protocol to quantify and monitor the impact of climate change and climate variability on ecosystems. A specific example is to evaluate climate change effects for the FIA-based Forest Assessment Model (partnership with SRS) in support of national assessments.
- Developing innovative methods/tools to improve the quality, timeliness, usefulness, and efficiency of existing production and request-filling processes; sampling, integrating remote sensing, small area estimates (rapid assessment tools, management scales, etc.), and improved land cover and use change analyses.
- Developing a fuller understanding of the origins of natural ecosystem patterns to guide, interpret, and communicate research.

- D. Inventory and monitor disturbance effects and impacts. Research is needed to quantify disturbance effects and characterize impacts on vegetation and other resources (wildlife, water, etc.).

The lack of comprehensive historical vegetation data over the Interior West states challenges the ability of scientists and land managers to understand cumulative effects of disturbance or management across the landscape. Research in this Focus Area will improve our capability to identify disturbance patterns using historical imagery and to determine the associated spatially explicit predictions of vegetation changes in volume, biomass, and carbon. Other applications of this type of change information may include mapping of the disturbance and subsequent recovery of lands affected by fires, storms,

and insects; and the subsequent historical impacts on wildlife, fire risk, invasive species, etc. and may include utilizing old inventories that are no longer on the national base grid.

This research will also pursue opportunities to use the strategic vegetation inventory and monitoring framework to support small and large scale rapid assessments of disturbance impacts on the vegetation resources.

Function 3: Inventory and Monitoring Applications and Customer Support –

Facilitate the use of the FIA strategic scale framework and data for filling special data and analysis requests, implement new applications and tools, leverage cooperative inventories, develop integrated resource analyses, and extend research findings across scales and ecosystems.

The FIA database is unique in its geographic and temporal scale. The annual addition of data continually provides new opportunities for analysis. These features, coupled with the availability of a nationally consistent core set of variables, have increased interest in the use of FIA data by a broad range of users. Often the need for vegetation inventory and monitoring data is unique to a specific land management agency, a particular issue related to forest plan litigation, or to other resource issues indirectly or directly related to vegetation. Sometimes the issue requires finer scales of information, needs further integration with other sources of information (e.g., specific geospatial layers), or requires new data collection measures or attributes. Few clients outside of the Program fully understand the data collection protocols, historic data collection and compilation issues, appropriate data retrieval, or are aware of the potential and/or any prior tested applications. The result has been an increasing demand by users for database documentation, direct support of their own analyses, and collaboration on mutually beneficial analyses. To effectively meet these application needs it is necessary to develop efficient methods that will permit the IM program to meet growing user demands.

With its extensive and ever-increasing scope, the FIA database can provide answers to questions about forest ecosystems that can only be addressed by a large, unbiased data set. Because the computation of certain FIA variables is dependent on models that come from a wide variety of sources, some of these questions are fundamental to FIA operations (i.e., Function 1). For example, it is now possible to analyze growth and yield characteristics on previously un-studied or under-studied species. In addition, it is possible to challenge or validate results of prior analyses that may have been done using limited data or outdated methods. In effect, the FIA program generates data that are both useful for internal quality control and replacement of obsolete models.

To serve these needs, it is necessary to support new user requests, develop streamlined methods for responding to recurring user needs, and, to the extent

possible, anticipate future Program and user needs by developing tools and techniques that utilize the unique features of FIA data. The objectives of this Function include:

- A. Data storage and retrieval techniques. This objective involves the continued development and refinement of storing and retrieving information in an efficient way that is transparent and intuitive to both internal and external users while maintaining the confidentiality of plot locations. These techniques include efficient and up-to-date access and guidance for both the National FIA data retrieval systems and local information sources.
- B. Spatial data services. This includes providing and improving spatial data services in cases where the spatial accuracy of the publicly-available FIA database is insufficient to meet user needs. Because the law requires confidentiality of field plot location, and many spatial analyses require exact plot coordinates, this Program can provide support through development of in-house processes to provide clients with the polygon or mapping information they need without compromising location confidentiality.
- C. Client training. Local information-delivery expertise (help desk) and development of effective on-line or live training courses in data access and appropriate data use are required to increase client awareness and skills in using FIA data. This objective may also be accomplished through partnerships in which Program staff helps identify the variables and analyses appropriate to the answer the client's questions and through effective documentation of data and analytical processes.
- D. Tools and application implementation. Tying in to the Inventory and Monitoring Techniques Research and Development Function, Focus Area C (Applications for planning, monitoring, adaptive management, and research), this objective includes creating, modifying, and/or implementing tools and applications that are developed from, or for use with strategic level data. These may be created by the IM staff, other Science program staff, or other partners. Items in this category typically fill long-standing knowledge gaps or are identified in response to broadly expresses needs in the areas of forest ecology, silviculture, or mensuration.
- E. Cooperative inventories. This objective includes the coordination and implementation of cooperative inventories to provide State or Agency-specific data collection, compilation, and analyses. These inventories support or enhance information and analytical needs of the National Forest System or other agencies. An example is the Region 1 all-condition inventory developed and piloted by the IM Program, whereby ground data are collected across all lands, including those not meeting the FIA Forest definition of 10% tree crown over. Other examples include mid-scale inventory and monitoring data, NFS All-Condition data collection, and planning/monitoring analyses. This is

consistent with the guiding principle to develop inventory methods and techniques that assist NFS in meeting requirements of the National Forest Management Act.

- F. FIA National Collaboration. RMRS Inventory and Monitoring Science Program staffs contribute to FIA National Bands and Task teams for development of national information management systems including data collection, compilation, storage, delivery, and spatial data services.

Cross-Program Collaboration – One key area of effective inventory and monitoring research and application includes collaboration with staff from other Science Programs – both internal to the Rocky Mountain Research Station and external with Universities and other organizations – to use current data/products for a variety of research applications and management decision-making support. These might include the assessment of forest and rangeland structure, composition, and health at the landscape scale and their relationship to critical wildlife habitat; susceptibility to insect and disease stressors; and response to climate change and disturbance. Collaboration may also include evaluation of the effects of land use change on fire risk, economic productivity of forest land, wildlife habitat quality, carbon sequestration dynamics, and others. In addition, cross-Program application could lead to the development of new tools and techniques to collect, compile, and use inventory and monitoring data for other resource analyses or assessments.

Several current examples illustrate other inventory and monitoring research that may offer opportunities to integrate with the IM Science program and enhance future applications of vegetation inventory and monitoring information. Researchers in IM, along with scientists from other **regional FIA Programs**, are developing more efficient forest resource sampling methods that integrate with remotely sensed and other spatial data and also are evaluating indicators for assessing rangeland health. **Wildlife research:** IM staff and cooperators are providing reliable information on wildlife populations and habitats; this includes non-invasive genetic surveys to monitor species distributions, population size and to model habitat connectivity, and multi-scale modeling of species-habitat relationships. **Fire research:** IM staff and cooperators are developing integrated systems of sampling methods and protocols, field sheets, databases, and analysis programs for the inventory and monitoring of resource conditions essential for assessing fire risks and effects. The LANDFIRE program is producing a set of models, maps and tools that describe fuel conditions, hazards, and fire potential. **Watershed and riparian research:** IM staff and cooperators are developing methods for monitoring watershed and riparian ecosystems of the semi-arid West. Other on-going research and development includes tools for **wilderness monitoring**, gradient models to predict micro-climate regime of forests at fine spatial resolution, correlating vegetation structure, growth processes, and disturbance regime with climatic conditions, and cost effective

techniques to estimate forage production, utilization, and ecological trends of rangelands. Program and other Station scientists serve as ***national resource assessment*** specialists for a number of resource areas, including rangelands, wildlife and fish, non-renewable resources, climate change, and water, in cooperation with the Forest Service Washington Office staffs for the Resource Planning Act and Strategic Planning. Also, ***rangelands and non-renewable resource*** specialists lead sustainability roundtables in their respective assessment areas. The roundtables, modeled after the Roundtable on Sustainable Forests, provide collaborative processes for identifying and verifying sustainability indicators that are applicable to rangeland and non-renewable resources.

FIA Annual Inventory Schedule

Implementation of the annual inventory (Start year in bold)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Arizona		X	X	X	X	X	X	X	X	X
Colorado			X	X	X	X	X	X	X	X
Idaho					X	X	X	X	X	X
Montana				X	X	X	X	X	X	X
Nevada					*	*				X
New Mexico									X	X
Utah	X	X	X	X	X	X	X	X	X	X
Wyoming										X

* Nevada annual data were collected for 2 years as part of a pilot in research Focus Areas A and B.

Staffing/Funding

The information provided below is based on the FIA Strategic Plan (2007) to fully conduct the annual inventory in all eight Interior West States. Staffing and funding include both the regional Program effort and Program contributions to national FIA efforts including information management, quality assurance, Resources Planning Act (RPA) work, national indicator leads, and support for migration of FIA data to NRIS.

FIA Portion

The National FIA Program is intended to be a cross-Deputy area and a Federal/State partnership. National Forest System funds were permanently transferred to FIA; State and private Forestry (S&PF) funds are appropriated independently. Individual States can contribute to conducting or enhancing the inventory (increase spatially, temporally, or with additional attributes), but the Base Federal Program is funded entirely through the appropriated Research and S&PF funds. For the Interior West FIA Program in 2008, Research provides \$11,523,000 and S&PF funds account for \$795,000.

Total funding targets for full implementation of the Interior West FIA Program were determined in 2006 at \$16,051,000 and included Inventory and Monitoring research and development.

Additional Funds

Additional appropriated Research funds are currently provided to the IM Program to support Landscape/Ecosystem analyses. For 2008, the Station provided \$170,000 to support this effort.

To administer the IM Program, employees are assigned to one of several organizational Teams, and the three Science Program Function Areas form the matrix to accomplish the work (a 1 indicates primary function of a team, 2 is secondary function):

Team	FIA		
	Function: Operations	Techniques R&D	Applications Customer
Support			
Administration (all functions)			
Data Collection	1		2
Information Management	2	2	1
Analysis	2	2	1
Techniques	2	1	2

FTEs/Year ^{a,b}	2008	2009	2010 and beyond
Administration staff	11.5	10.0	10.0
PM, Safety, Support			
Data Collection Staff	69.0	90.0	90.0
Analytical Staff	8.5	9.5	9.5
Information Management Staff	11.5	13.5	16.0
Subtotal FTEs	100.5	123.0	125.5
Funding/Year (thousands) ^c	\$11,462	\$15,800	\$15,800

FTE's/Year	2008	2009	2010 and beyond
Scientists	2.0	3.0	3.0

Professional support ^d	5.5	4.5	4.5
Subtotal	7.5	7.5	7.5
Funding/Year (thousands) ^c	\$1,026	\$1,200	\$1,200
Total FTEs	108.0	130.5	133.0
Total Funding (thousands)^c	\$12,488^e	\$17,000^f	\$17,000^f

^a to implement all 8 States as planned, and includes national positions (Information Management and Quality Assurance).

^b includes FTEs for data collection (11) and analytical staff (2.5) currently contracted through cooperative agreements

^c includes Station overhead

^d includes 1 FTE ecosystem analyses

^e Current allocation based on fixed ceiling established in 2004 for FIA with no cost of living included

^f Based on 2006-2007 FIA Strategic Plan data brought up to 2009.

IM CROSSWALKS with Other RMRS Program Charters

Fire Fuel Smoke

1. Physical Fire Dynamics
2. Fuel Dynamics (1, 3)
3. Smoke
4. Fire Ecology
5. Fire & Fuel Mgt
6. Science synthesis & delivery

Grasslands Shrublands, Deserts

1. Disturbances (2D)
2. Invasive Plants (2C)
3. Restoration
4. Sustaining/Managing
5. Climate Change (1, 2C, 2D)

Wildlife and Terrestrial Habitats

1. Natural Disturbances, restoration, fuels reduction (1, 2D)
2. Invasive species and diseases (2C)
3. Conservation genetics
4. Species and Habitats at risk
5. Human/wildlife interactions
6. Inventory & Monitoring (1-3)

Air, Water, and Aquatics

1. Ecosystem response to changing environment (interdisciplinary, integrated) (2-3, various)
2. Rapid Response
3. Water supply/Quality
4. Conservation & restoration of aquatics/vegetation (riparian, terrestrial)

Forests and Woodland Ecosystems

1. Basic ecology
2. Chemical and physical processes
3. Disturbance processes and interactions (2D)
4. Vegetation, fuels management, restoration
5. Quantitative tools and technologies (2C)
6. Climate Change (1, 2C, 2D)

Integration of Human and Ecological Processes

1. Resource forecasting, decision-making, & risk assessment (theoretical framework & models);
2. Market and non-market resource valuation tradeoffs
3. Getting multi-stakeholders to collaborate (value of place vs communities of interest), conflict mitigation
4. Socio-economic drivers behind ecosystem change
5. RPA (1,3)

Themes: climate change, FF management, water/recreation management

ALWRI

1. Recreation: experiences/impacts
2. Relationships (value/conflict/trust)
3. Fire (wildland fire use)
4. Larger systems (social/ecological impacts) – (1)
5. Science delivery and application

Staffing

Location	Name	GS-Series	Title	FIA Operations	Techniques R&D	Applications Customer Support
Ogden	Michael Wilson	0401	Program Manager	.33	.33	.34
Ogden	Renee O'Brien	0401	Deputy Program Manager	.33	.33	.34
Ogden	Gretchen Moisen	0460	Research Forester		1.0	
Fort Collins	Ray Czaplowski	1529	Research Mathematical Statistician		1.0	
Fort Collins	Robert Bailey	0150	Geographer		1.0	
Ogden	John Shaw	0401	Biological Scientist	.33	.33	.34
Ogden	Mike Thompson	0460	Forester	.45	.10	.45
Ogden	James Menlove	0408	Ecologist	.45	.10	.45
Ogden	Jock Blackard	0460	Forester		.50	.50
Ogden	Tracey Frescino	0460	Forester		.80	.20
Ogden	Sean Healey	0408	Ecologist		1.0	
Fort Collins	Paul Patterson	1530	Statistician	.10	.80	.10
Ogden	Larry DeBlander	0460	Forester	.50		.50
Ogden	Christopher Witt	0408	Ecologist	.50	.50	
Ogden	Chuck Liff	1550	Computer Scientist	.50		.50
Ogden	Sharon Woudenberg	0460	Supervisory Forester	.50		.50
Ogden	Kent Mueller	2210	IT Specialist	.50		.50
Ogden	Susan Brown	2210	IT Specialist	.50		.50
Ogden	Mark Rubey	2210	IT Specialist	1.0		
Ogden	Ron Tymcio	0401	Geographic Information Systems Specialist	.33	.33	.34
Ogden	Bob Rhoads	0460	Supervisory Forester	1.0		
Portland, OR	Phyllis Adams	1530	Statistician	1.0		
Ogden	Bill Dunning	0460	Supervisory Forester	1.0		
Madison, WI	Bryan Lanier	2210	IT Specialist	.50		.50
FTE Totals				9.82	8.12	6.06

