

Foundations for the Future:
*Findings from a Survey of Inventories
Managed by Regional Offices
of the Forest Service*

November 1, 1999

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Executive Summary

The Interregional Ecosystem Management Coordinating Group (IREMCG) asked the Inventory and Monitoring Institute to survey inventories sponsored or managed through Regional Office staff to evaluate current programs with regard to the following six interest areas:

1. Involvement of Forest Service Research
2. How Regional efforts utilize Forest Inventory and Analysis (FIA) procedures and data
3. How Regional inventory designs are coordinated across scales and administrative boundaries
4. Statistical methods and analyses used
5. Quality assurance procedures
6. Connections between inventory designs and Natural Resource Information System (NRIS) database structures

During August 1999, the Institute convened a survey team to fulfill the request from the IREMCG. The survey reflects inventories that are primarily national and regional in scope, and includes to a lesser degree forest and project inventories. The survey is intended to capture significant information about inventories; it is not intended to be a comprehensive description of all inventories conducted by the agency. Because of time limitations not all resource areas within Regions and across the agency could be included in the survey to the extent the team felt necessary; therefore, it is very important that future pursuit of the recommendations herein be done with involvement across all resource areas both within Regions and across national programs.

The survey team used the six interest areas proposed in the IREMCG request to gather information about inventories. The general summary of findings for each of those interest areas is included in section six of this report. More importantly, the findings from the survey have been synthesized into five significant areas of concern :

1. Business requirements and purpose of inventories

- Develop an overarching national statement of purpose and objectives that encompasses all resources, and serves as a guide point for the management of inventories that support business requirements of the agency.
- Based on agency business requirements, the IREMCG should evaluate if NFS is adequately represented on the FIA executive committee.

2. Systematic approach to inventory

- Work across Regions to establish a systematic approach to guide the development, long-term maintenance, and management of an inventory program that encompasses all resources and is soundly based on business needs of the agency.
- Work across Regions for consistency in design and management approaches. Build from the organizational approaches and systematic design processes that Regions have successfully applied in current "integrated inventory" programs, and incrementally improve programs to reflect ecological, social, and economic systems.

3. Inventories across ownerships

- Establish inventory partnerships across governments and across levels within agencies.
- Create a national inventory "working group" with BLM, Park Service, States, NRCS, FWS, EPA, USGS Biological Resources, other government agencies, and other governments. The purpose of such a group would be to make recommendations and/or agreements for coordination, and communicate the vision and status of the various systematic inventories and monitoring to appropriate line and staff levels within their agencies.

- Work across Regions to identify minimum inter-regional core data and standards based on business needs across organizational levels and program areas.

4. Communication and accountability

- Provide training and education components for inventory and monitoring programs.
- Formulate strategy for agency-wide and public access to both data and the agency's framework for inventory and monitoring via the internet.
- Streamline various reporting requirements to ones meaningful by scale and align reports with business requirements.

5. Management and organizational roles

- IREMCG should make recommendations to restructure the directive system to be responsive to business needs and operations related to inventory.
- Continue to refine annual performance measures to: a) reinforce a systematic, multi-scale framework for inventory; b) reflect agency priorities for integrated inventory; and c) increase accountability for NFIM expenditures by Regions and program staffs.
- Each Region should designate a person or team responsible for inventory program coordination among staffs and external cooperators. The Washington Office should designate a person, team, or program staff charged with championing coordination and exercising leadership for improving efficiency and effectiveness of inventory programs throughout the agency.
- The IREMCG should sponsor development of Regional strategic inventory management plans that are connected to a national statement of purpose and objectives.
- Enlist IMI to help the define and development of systems approaches to inventory design and implementation.
- Actively engage Forest Service Research, and State and Private Forestry to help define and develop a systems approach to inventories.
- Work across Regions to define a corporate process through a series of technical papers addressing important inventory and monitoring topics, and facilitate access to existing papers that express current agency views and techniques through the internet and other media.

Introduction

The Interregional Ecosystem Management Coordinating Group asked the Inventory and Monitoring Institute (IMI) to survey inventories sponsored by or managed through the Regional Offices. The following six interest areas were initially suggested.

1. Involvement of Forest Service Research and Development
2. How Regional efforts utilize FIA procedures and data
3. How Regional inventory designs are coordinated across scales and administrative boundaries
4. Statistical methods and analysis used
5. Quality assurance procedures
6. Connections between inventory designs and NRIS database structures

The Institute proposed using a survey team of representatives from each Region, and refined the scope of the effort to focus on inventories (not monitoring) managed through Regional Offices (not including detailed data from Forests and project inventories). This proposal was approved by the IREMCG in July 1999. The survey team gathered information during August and convened to synthesize findings during that same month. Findings were reviewed and revised in September. Based on information gathered about these six interest areas and more detailed questions posed to inventory managers, the team identified five major issue areas that are the basis for the organization this report. A final section specifically addresses the six area suggested by the IREMCG. Consequently the six primary sections of this report are:

1. Business Requirements and Purpose of Inventories
2. Systematic Approach to Inventory
3. Inventories Across Ownerships
4. Communication and Accountability
5. Management and Organizational Roles
6. Summary of Responses to Six Interest Areas

The objective was to identify strategically important facts and to develop recommendations to the IREMCG based on findings. Individuals responsible for centrally managed inventory programs or coordination functions served on the survey team and searched out information from relevant staffs within their Region. These survey team members collaborated on the synthesis of findings and formulation of recommendations in this report. The findings and recommendations primarily represent an NFS situation and viewpoint, with input from a few Regional S&PF program managers. The assessment conducted by the team included interviews with and distribution of questionnaires to program managers in NFS and S&PF. The questions posed are listed in Appendix A: Questionnaire Form. The survey team members felt that they obtained significant input from about 80 percent of the inventory programs managed through Regional Offices. The information provided by Region 10 was derived from its recently completed strategic inventory plan. In addition to questionnaire replies, participants also relied on findings from the recent implementation planning for NRIS. The responses to the questionnaire are retained as internal team records and for reference by each Region.

The findings and recommendations address significant efforts now being made to inventory the water, wildlife, range, vegetation, recreation, land, mineral, and human dimensions of natural resources. Some Regions reviewed their inventory programs during the era of organizational reinvention, and have adjusted staffs and program responsibilities to coordinate inventory activities. There is consensus that these re-engineered programs are improving the efficiency and credibility of inventories and are

important bases for further improvements. The work previously sponsored by the IREMCG leading to the development of NRIS should continue. Several times over the past few years the agency has formed work groups that assessed needs for improvements. A few resulting actions have started to demonstrate progress in improving inventory programs. There are situations that hamper the ability of the agency to fully realize the benefits of the re-engineered inventory programs and NRIS. The agency needs to actively engage Research and Development, State and Private Forestry, and program managers across all resource areas while following through on the recommendations contained herein to improve the efficiency and credibility of inventory efforts throughout the agency.

Key Issue 1: Business Requirements and Purpose of Inventories

Inventories conducted throughout the agency have evolved to address needs that are unique to specific assessment reports and local needs. These needs vary across spatial and temporal scales. Many Regional Offices have been re-engineering their management of inventories along two lines; 1) to improve the efficiency of operations by better applying scarce expertise in sampling design, quality assurance, data management, and analysis; and 2) to design an information foundation from which special surveys can be developed. Building foundational data from continuously mapped inventories and statistically rigorous field surveys can position the agency to respond to the trends in assessments and planning direction suggested in the proposed LRMP planning rule.

Because the agency is committed to decentralized management and innovation, it is no surprise there are several apparently useful ways to organize and manage Regional inventory programs. Each Region has as fundamental components of their inventories both mapped and field-collected data. However, the approaches used to develop maps and to collect data in the field, differ. If a chief concern of the IREMCG is to foster consistency across Regions, then an initial focus on business requirements of the agency and the purpose of our inventories is needed. This should be done at each level within NFS, starting with the WO. The purpose can include the various business needs but may also encompass more than just these current needs. When Region 6 developed its Terrestrial Inventory and Monitoring program, the purpose and objective statement guided overall direction. Without such agreement at all levels by all resources, that agency will have diminished ability to integrate multi-resource information and effectively budget for inventory priorities. The following table summarizes the current Forest Service business needs, and types of inventory programs supporting these needs.

Administrative Scope	Management direction or Product	Purpose of inventory or assessment using data	Current Inventory & Monitoring Program
National	GPRA Strategic Plan	National - RPA Assessment	FIA (including FHM) with some unique Regional supplementary data
Cross-Regional	Ecoregional assessment reports	Ecoregional assessments	Re-use of variety of existing programs with some unique efforts developed
Regional	Strategic Priorities	NFS Regional and collaborative ecoregional assessments	Unique to Regions' needs; also national programs such as Air, Infra, Partners in Flight
Forest	Forest Plans	Landscape & Watershed assessment, TES and MIS monitoring	Unique to local needs
District	Project Plans	Project EA's, NEPA	Unique to local needs

An overarching understanding of inventory programs and their purpose in a broader context seems to be lagging behind the demands and expectations of our decision-making processes and assessment efforts. In the past, inventories have generally served to manage assets or provide site-specific data in support of project-level NEPA assessments. The need for inventories that are linked across spatial and temporal scales has become more obvious with ecosystem management and conservation strategies. We seem to

lack a uniform, collective understanding of the purpose and objectives for inventories and how inventory activities interface with monitoring needs. An overall agreement on a statement of purpose, objectives, and definition of inventories is needed. Without such agreement and accepted principles, inventories across resources tend to deviate to the most pressing/current crisis of the moment, and our ability to communicate the state of resources and effects of management practices is diminished.

Building consistency and compatibility across inventories should primarily be in support of meeting our common business needs. Business requirements analysis would focus attention on what the agency now needs to do, what data it needs to do its job, and how it uses that data. Some Regions have been attempting to apply this rigor to their inventory efforts. Without core business needs at the national, Regional and Forest levels, however; we remain focused on local or issue-driven needs rather than common needs. As an example of the proliferation of inventories driven by local objectives, the Region 10 study found 262 monitoring, inventory, and administrative studies that were replete with duplication of effort, lack of standardization, and lack of coordination. Consequently the Region has formulated eight specific action plans designed to meet business needs congruent with NRIS modules so that efficiencies are gained throughout the Region.

Although the NRIS program is making progress in supporting storage of and access to data across functional areas, few inventories have been purposefully designed to capture common or core needs and address how the data needs to be used. Examining how data are used and processed fosters efficiency and credibility of programs and operations. There are concerns about whether data from mixed pedigrees can be accessed for credible analyses in the future and about the level of analytical skills needed to avoid erroneously processing data from mixed inventory protocols. Regions and the NRIS module leaders have recently completed the initial round of implementation planning to set the stage for managing the collection and use of data from inventories. Now is an excellent time to ensure that genuine business requirements will be addressed by future inventories, and that sound quality management systems are used to foster scientific credibility of inventory data.

Recommendations:

1. We need overall agreement on an overarching national statement of purpose and objectives for inventory and monitoring that encompasses all resources, and serves as a starting point for the purpose and objective of inventories supporting the business requirements of the agency.
2. Based on agency business requirements evaluate if NFS is adequately represented on the FIA executive committee.

Key Issue 2: Systematic Approach to Inventory

Some regions are in various stages of implementing Regional inventory programs that integrate data into common structures, through common methods, and foster efficiencies in field operations. These inventory programs are commonly referred to as "integrated inventories." Regional managers of 'integrated inventories' point out that integration most often occurs when field operations are coordinated for sake of efficiency, and where data are brought together through analyses. Although the 'integrated' inventories attempt to combine parts of functional inventories, there is concern that for many of these inventories the processes inherent in ecological, social, and economic systems are not reflected in the design. Where the greatest degree of congruence exists are those inventories such as ECOMAP where there is a mature basis for ecological classifications. In spite of these forms of integration, the data produced are different enough to be potentially incompatible across Regional boundaries and ownerships.

On the national scene, FIA is transitioning into a broader and more consistent suite of core variables and sampling protocols to expand from a primarily commodity focus to include forest health measures and monitoring goals. This transition will take several years to complete, however. Even with this suite of measurements, FIA program is mandated to fulfill strategic information needs, not site management needs. The Inventory and Monitoring Institute advocates designing inventories from a basis that includes analysis of systems, an approach that should result in more resilient inventory and monitoring programs that are more likely to meet the needs of changing issues over time. Presumably, a systems approach to inventory design and management would result in data that can be analyzed in a variety of ways that can flexibly accommodate summary across socio-political, administrative, economic, and ecoregional boundaries. Whether the goal is to improve efficiency and understanding through integrated resource inventories or to take a 'systems approach' to inventory design, a systematic method for describing, refining, and continuously improving agency inventories is timely.

When most of the effort is directed toward inventories that are issue-driven -- such as by threatened and endangered species -- or based on an individual resource need, there is risk of having a shotgun mosaic of inventories that lack any continuity. Efforts in Regions 3, 5, and 6 demonstrate that inventories can be designed to collect information in a progressive manner so that data could be used to address multiple issues or set the stage for special surveys. This may become increasingly important as the draft LRMP proposed rule calls for a 'loose-leaf' approach to plan revisions and Forest and project-level decisions to be made within the context of ecoregional assessments.

Data collection methodologies or protocols typically are not consistent within resource programs across Regions. Some programs -- such as soils inventories -- are consistent because they are required to follow NRCS standards, and memorandums of understanding are in place at the national, State, and survey level to ensure this degree of consistency. But other programs such as vegetation inventories are variable from region to region and between FIA units. The progress toward standard procedures and analytical tools for vegetation inventories appears to be more cohesive than for inventories related to water, wildlife, watersheds, range, heritage, socio-cultural, recreation, and non-traditional commodities. Several of these areas are developing national strategies to improve consistency and efficiency of inventories. For examples, Region 3 has made notable emphasis in addressing range vegetation protocols; and national leaders for aquatic biology and hydrology are beginning to formulate strategies to gain consistency throughout the agency. It is timely to define national strategies across functional

areas and within the context of business requirements in order to effectively budget for inventory programs.

Because inventories tend to be single resource and issue driven, funding from year to year is variable and unpredictable. Disproportionate funding among resource programs seems to lead to inefficient inventory programs and a deeper entrenchment in a functional approach to resource management. Single-purpose short-term inventories have limited utility. Resource areas need to define inventory programs through a consistent process, and accurately estimate funding needed to meet management expectations for scientific credibility. It is critical to have longevity in inventory programs in order to leverage scarce skills, complex technologies, and sustain continuous improvement processes. When Regions and Forests redirect funding slated for inventory activities to other management priorities, reliable inventories are not sustained and the stability of inventory programs is thwarted. Stability and longevity are critical if inventory programs are to support monitoring for implementation, effectiveness, and validity of management actions.

Recommendations:

1. Work across Regions to establish a systematic approach to guide the development, long-term maintenance, and management of an inventory program that encompasses all resources and is soundly based on business needs of the agency.
2. Work across Regions in design and management approaches. Build from the organizational approaches and systematic design processes that Regions have successfully applied in current "integrated inventory" programs, and incrementally improve programs to reflect ecological, social, and economic systems. Adopt approaches that provide a level of consistency that improves efficiency and credibility of the agency and is complemented by approaches that are compatible, recognizing some ecoregional differences may be appropriate.

Key Issue 3: Inventories Across Ownerships

Often, inventories on National Forests and Grasslands cover only portions of watersheds, administrative units, or ecological areas. In some cases, the Forest Service relies upon inventories conducted by others (BLM, NPS, BIA, States, NRCS, FWS, EPA). Because the rigor and design of inventories by other agencies may differ, the ability of all parties to feel confident in the data resulting from inventories is compromised, which complicates ecological assessments and sharing of data when partnerships are not in place. Even when data collection methods and sampling protocols are carefully and rigorously agreed to through partnerships across inventory programs, the stewardship responsibilities of the data remain ill-defined. Sustaining data collected by other agencies in a common repository can make access and use more efficient for staff specialists, but few agencies are in a position to take on the long-term commitment for such a style of stewardship. Thus the Forest Service and other agencies usually have to rely on time-consuming and costly efforts to periodically recompile data for specific analyses.

The Forest Service core data needs, which relate to broad, strategic-level inventory, are limited to the FIA national core set that has not been uniformly applied across the nation. Standards by the Federal Geographic Data Committee (FGDC), like all standards efforts, are continuously evolving. The evolution of standards is dependent on both the pace of negotiations for standards and the active evolution of the scientific bases for inventory protocols. Field personnel wrestle constantly to balance current inventory activities with changing standards. Some examples where national standards are not fully mature include:

- Range inventory and monitoring protocols. Agreements between NRCS, BLM, and Forest Service on range data protocols are pending. Until those agreements are in place, it may be inefficient to proceed with an inventory program or negotiate for services from FIA for inventories on rangelands.
- EPA on water quality monitoring. Integration of EPA programs to fulfill water quality monitoring business needs of the Forest Service is needed.
- Wildlife inventory and monitoring. Efforts among agencies associated with GAP, NWI, and formulation of biological opinions lack coordination. We have many wildlife inventory and monitoring efforts, especially population monitoring needs, where the agency partially sponsors inventory or census conducted by others, typically States.
- FIA. We have obligations with States and the public at large to sustain strategic-level inventory of forest resources. Information needed for management of sites by NFS staffs are not fully incorporated, and currently NFS is not represented as a customer on the executive committee for FIA. The relationships between strategic information and information needed for forest and project-level decisions have not been defined so there is confusion about how both sources of information can complement or support ecosystem analysis and planning.

Recommendations:

1. Establish inventory agreements with land management partners at both the national and Regional levels.
2. Create a national inventory "working group" with BLM, Park Service, States, NRCS, FWS, EPA, USGS Biological Resources, other government agencies, and other governments. The purpose of such a group would be to make recommendations and/or agreements for coordination, and communicate the vision and status of the various systematic inventories and monitoring to

appropriate line and staff levels within their agencies. Such a group (including users) might consider the following tasks:

- Facilitate resolution of coordination needs such as those mentioned above in the Issue Statement.
 - Foster federal agency partnerships for certain strategic level inventories (EPA, USGS, on water quality and some aquatic biota; FWS on TES inventories at an ecosystem level; EPA, NRCS, and FWS on Ecological unit inventory; etc.) and establish common strategies and agreements at a national level.
 - Identify and link inventory designs and methods among agencies. Define core data, agree to base maps, understand core variables, and solicit proposals from potential lead agencies. Encourage consistent, systematic inventories across all ownerships. A Model for this are the Alaska Region permanent plot grid and Forest Health Monitoring Design (with State and municipal lands and native corporation lands).
 - Identify common business needs/clients served among agencies. This information could be used to design consistent and compatible inventories at different hierarchical levels such as those associated with ECOMAP, Major Land Resource Area (MLRA), and the Natural Resource Inventory (NRI).
 - Establish interagency data standards and identify lead agencies for housing or stewarding shared data such has been done for ECOMAP and NRCS soil inventories.
 - Gain agreement across federal agencies for common base map themes that provide consistent characterization of lands across federal ownerships. Ideally this would extend to include similar congruence with State, tribal and other ownerships, especially as a foundation for broad-scale assessments such as those suggested in the LRMP proposed rule.
3. Identify minimum inter-regional core data and standards based on business needs across organizational levels and program areas.

Key Issue 4: Communication and Accountability

The Survey Team has purposefully chosen to address communication and accountability as related issues rather than individually. Continuing to perceive and treat these efforts as isolated tasks will continue to exacerbate our difficulties in fostering a sense of customer confidence in our inventory programs and data. Three major areas of concern are (1) the use of data gathered through inventories, (2) the variety of reports generated and their suitability to customers, especially the public, and (3) our ability to communicate with the public the purpose of and findings from inventories.

The agency is striving for scientific credibility of our inventories, but there is rarely understanding among employees of what scientific credibility means within the context of inventory programs. Scientific credibility of inventories is the combination of (a) tested and accepted protocols, (b) quality assurance practices, and (c) quantification of uncertainty throughout the design and implementation of an inventory (including analysis phases and portrayal of uncertainty associated with information, maps, and reports).

Inventory dollars are used to purchase data and information from outside sources or partially fund large programs as a co-sponsor with other agencies or States. Information used with GIS and remote sensing technologies requires investments that differ from the operational activity of collecting inventory data in the field. Some degree of distinction is needed to accurately account for how and where funds are spent. Aspects of accountability associated with legal requirements such as reporting through the MARS are also addressed under key issue 5, Management and Organizational Roles.

The agency has been criticized for poorly communicating the status of assets and services, and poorly describing our inventory and monitoring efforts in a manner that is highly relevant to our customers (Congress, the public, and employees). We produce a plethora of reports that vary in form and accessibility to the public, ranging from internal reports to glossy publications that attempt to convey meaningful information, but they do not seem to convey key messages about agency inventory policies or program practices. We need a clearly articulated approach or framework that explains the purpose, scope, uses, and findings from inventory programs.

There seems to be low level of understanding throughout the agency for terminology associated with inventory and monitoring, and a mixed level of adoption of standards for quality assurance, data definition, and inventory operations. The confusion over terminology exacerbates our ability to monitor, coordinate, and manage investments in inventories. Furthermore, our own mixed use of terms makes it difficult to articulate a consistent explanation of what we inventory and how we inventory.

The agency needs to anticipate prolific use of the internet as a vehicle for delivering data and findings from inventories. To do this in a credible way, we will need to clearly describe the limitations of data and convey the level of certainty and uncertainty associated with data we provide. We must be able to describe the design and intent of an inventory in order to have any hope that the data will be used in ways that are congruent with its origin and/or statistical reliability. NRIS provides tremendous flexibility for storing data that originates from a variety of inventory protocols and a variety of standards for quality control. There is concern that the mixture of data in NRIS will pose significant risks to (1) our ability to use data wisely within the agency, and (2) having data inadvertently misused by others not

intimately familiar with the various protocols and quality standards that the agency employs. Regions are relying on NRIS to improve our management of inventory records by:

1. Serving as an agency atlas of terms, definitions, and valid values.
2. Providing access to data and levels of uncertainty associated with data.
3. Providing a basis set of applications that use standard terms, and definitions.

Recommendations:

1. IREMCG should work with the corporate training office to develop a training and education program for inventory and monitoring that will increase agency-wide understanding and core competencies related to inventory design, quality management, and data analysis. This program should include the use of GIS and encourage access to internet-based continuing education opportunities.
2. Communicate the agency's inventory and monitoring framework and results to employees and the public via internet and other media. Formulate a strategy for agency and public access to data and ensure useful descriptions of data quality exist.
3. Streamline reporting requirements into those that are meaningful by scale and align reports with business requirements, address the variety of 'accountability' reports such as forest monitoring reports, State of the Region Reports, and Regional Forester and Station Director Performance Element reporting. Continue to devise strategies for organizing the variety of views of agency outcomes represented by GPRA, C&I, and MARS.

Key Issue 5: Management and Organizational Roles

The distributed authority and responsibility for inventory programs throughout the agency provides significant opportunities for individual program areas and Regions to devise unique organizational structures, policies, and operations. Coordination across Regions and program areas generally is limited to collaboration required by high-profile bioregional assessments. Relatively few positions within Regional Offices are designated to lead and manage inventory programs. Where these designations are being implemented -- such as in Regions 5, 6, and 10 -- the agency is positioning itself to benefit from coordination prior to crisis situations or one time assessments. Such coordination fosters mutual development of protocols, promotes consistent expectations and management practices across Regions, and facilitates credible reporting of inventory programs and data. These results would be further enhanced with improved coordination across program areas at the national level. Building upon existing successes would result in each Region designating a person or team responsible for inventory program coordination across NFS program areas, State and Private Forestry, and Forest Service Research. This effort would strengthen coordination with other regions, aid partnerships with external organizations and oversight of interagency agreements, improve attainment reporting, and facilitate informed priority setting and NFIM budget allocations.

The benefits that Regional Offices are receiving from central inventory management approaches could be more effectively spread across the agency through the designation of a person, team, or program staff at the national level. This position should also be responsible for inventory program coordination across Deputy areas, program areas, and Regions, and partnership development with external organizations. Consolidating all Forest Service Manual and Handbook direction related to inventory into a single file designation would improve awareness and application of inventory direction, and expose opportunities for improved integration between program areas. Also, the agency has designated several ad hoc teams to examine inventory and monitoring programs over the past few years. From these recommendations incremental progress is being made; however, without a lead person or group to monitor progress the IREMCG, EMCT, and individual staff directors risk repeatedly requesting similar reviews from year to year.

Sporadic inventory partnerships with external organizations limit the availability, consistency, and timeliness of information about resource conditions on other lands. Thus, there is a need and opportunity to increase partnerships with other organizations such as the NRCS, EPA, USGS, FWS, tribal governments, BIA, State agencies, and other organizations. Well-organized inventory partnerships with other organizations could improve the Forest Service's ability to consider cumulative effects and broader contexts in its resource management decision-making.

Recommendations:

1. IREMCG should make recommendations to restructure the directive system to be responsive to business needs and operations related to inventory.
2. Continue to refine annual performance measures in order to reinforce a systematic, multi-scale framework for inventory; reflect agency priorities for integrated inventory; and increase accountability for NFIM expenditures by Regions and program staffs.
3. Each Region should designate a person or team responsible for inventory program coordination among staffs and external cooperators. The Washington Office should designate a person, team, or program staff charged with championing coordination and exercising

leadership for improving efficiency and effectiveness of inventory programs throughout the agency.

4. The IREMCG should sponsor development of Regional strategic inventory management plans that are connected to a national statement of purpose and objectives. Such plans would address upward reporting, the role of Research, the role of FIA, interagency agreements, and the core data set across Regions and within Regions; demonstrate where data and information from inventory activities supports planning (NFMA), decision-making (NEPA), and national reporting (SPRA); ensure inventories are economical in their design and implementation; and demonstrate that the investment adds value to management. These plans would form the basis for dialog among Regions on differences and similarities, and help the agency articulate its inventory management policies and practices.
5. Enlist IMI to help the define and development of systems approaches to inventory design and implementation. This may include evaluating existing integrated inventories, and providing guidance towards future inventory designs, standards, and reporting elements, and facilitating internal and external coordination.
6. Actively engage Forest Service Research, and State and Private Forestry to help define and develop a systems approach to inventories.
7. Work across Regions to define a corporate process through a series of technical papers addressing important inventory and monitoring topics such as statistical design, sampling methods, protocol selection, quality assurance practices, certification of designs, technology applications, and analysis methods. Facilitate access to existing these papers that express current agency thinking, views and techniques through the internet and other media.

Response to IREMCG interest areas:

Six interest areas were explicitly stated in the request for this survey. Survey team members were asked to author responses to each of the six interest area questions, based on information survey team members obtained from program managers in each Region and on their own knowledge of inventory policies and practices throughout their respective Regions. These interest areas were:

- 1. What has been the role of Research in inventories managed through Regional Offices?**
- 2. How have Regional efforts utilized FIA procedures and data?**
- 3. How are Regional inventory designs are coordinated across scales and administrative boundaries?**
- 4. What statistical methods and analysis are being used in inventories?**
- 5. What quality assurance procedures are used?**
- 6. What connections exist between inventory designs and NRIS database structures?**

The responses received by the Inventory and Monitoring Institute have been synthesized into the following portrayal of situations across all Regions. This summary is based on responses from Regions 1, 2, 3, 4, 5, 6, and 10 which are also provided in Appendix B. Unlike the prior sections of the report, this synthesis does not represent consensus across all survey team members, but is solely the opinion of the survey team leader.

1. What has been the role of Research and Development in inventories managed through Regional Offices?

The role of Research and Development has been highly varied across resource subjects throughout all Regions. The primary types of activities Research and Development has been engaged in include:

1. Development of protocols for field measurements and documentation of these through General Technical Reports and special publications that some inventory programs have accepted as 'standards' for collection methods.
2. Participation in statistical design of inventories.
3. Expert advice on incorporating important data needs relevant to management questions based on existing knowledge derived from past and ongoing Research projects.
4. Development of inventory, and (especially) monitoring, program specifications for specific projects and bioregional assessments.
5. Advice and assistance in quality reviews of inventory program components such as sampling design, protocol selection, and science basis for inventories.

Additionally, Research scientists within the agency have:

1. Conducted special purpose collections of data associated with specific studies,
2. Devised monitoring programs, such as wilderness monitoring, that Regional Office personnel rely on as primary guidance for effective and scientifically credible monitoring activities, and
3. Used data collected by inventories as means of augmenting data sets for specific studies.

Existing inventory programs and emerging approaches to inventory will continue to rely on Research for:

1. Statistical advice and assistance for large and small scale projects.

2. Scientific studies that address indicator and focal species response to habitat changes and management effects.
3. Scientific information on ecological processes and classification schemes that support inventory programs in describing current conditions and predicting future conditions.
4. Development of analytical techniques that can be applied by resource specialists for a variety of purposes.
5. Development of field measurement protocols through collaboration across Stations and with external scientists to identify scientifically credible and cost efficient means of inventorying assets, measuring public/consumer satisfaction in the quality of programs and assets, and monitoring for implementation, effectiveness, and evaluation of agency programs.
6. Identification of areas of interest that require research because the existing science base is not adequate.

2. How have Regional efforts utilized FIA procedures and data?

FIA data (for forested areas and to a lesser degree non-forested areas) are used by Regions to:

1. Assess National Forest conditions and activities within the context of landscapes or State-wide perspectives -- i.e. large-scale assessments that cross administrative boundaries.
2. Estimate resources for use in development of forest plans (especially in the East and to a lesser degree in the West),
3. Serve as a basis for intensified studies for specific local assessments that use additional plots and data elements.

Additionally, the FIA grid and plots have been used as a foundation for additional data collection efforts intended to relate core FIA and FHM data to resource specific studies such as insect and disease conditions and behavior.

National Forest Systems resource programs are interested in furthering the linkages between the FIA data and Regional scale inventories by actively participating in the identification of data elements and measurement procedures that are considered the core national data set of FIA. FIA also has the potential to provide data across ownerships to help NFS understand the context of management decisions over broad landscapes and throughout States. As FIA core data elements are expanded to encompass a more robust suite of ecological (including social and economic) indicators, the ability of FIA to provide a context will be greatly enhanced. NFS staffs also value the efficiency of leveraging existing FIA for field data collection rather than creating potentially duplicative inventory programs. In order to fully realize the value-added information that the FIA program could provide to NFS additional data may need to be collected. This led to the survey team recommendation that IREMCG evaluate if the NFS representation within the FIA executive committee and technical bands is satisfactory.

3. How are Regional inventory designs coordinated across scales and administrative boundaries?

Inventory designs are coordinated across scales and administrative boundaries through three venues: (1) the way that a Region has chosen to organize and oversee inventories, i.e. coordination through management style; (2) the degree that a survey or inventory is associated with established partnerships

and alliances for design and implementation; and (3) the degree that resource program managers use and enforce national program protocols and standards. Depending on the resource subject area, any one or a combination of these techniques are used in the Regional Offices.

Regions either have one primary inventory coordinator within the Regional Office, or a series of program managers associated with overseeing surveys and data collection for specific resource areas. Even where a Region has designated a single inventory program coordinator, that person does not have full authority over all inventory design, management, and budgeting activities across all resources. The scope of central coordination varies among Regions; and the most readily recognized coordinator for a Region is typically the vegetation inventory coordinator. To a degree this has lent a vegetative flavor to some of the Regional inventory programs reported through this survey.

Most often, Regions with central inventory coordinator(s) typically address several resource subjects, but not all. The most common centrally coordinated programs are: the ecology classification program, the soil classification and mapping program (more recently known as the ecological unit inventory), the stream inventory program, and the current terrestrial vegetation inventory and monitoring program. When a Region has taken a rigorous centralized approach to managing and conducting inventories, the scope involves both administrative and technical support for data management, operational activities, and training. The degree that each of these elements is rigorously managed varies from Region to Region. Hence, there is consensus that inventory coordinators in Regions would like to have an established forum or national framework to help them share "best practices" and improve programs over time.

Most Regions have 'contracted' with FIA to collect all forest inventory data using FIA sampling (grid and mapped plot) design and data collection protocols. Plot data collected on the grid will usually need to be supplemented to provide adequate samples for individual forest planning and management needs. Several Regions have used more intensive surveys where necessary for assessments, or are using FIA data to validate some of the forest typing portrayed in map themes.

Specific resource inventories such as heritage program, air and water, soils, water systems, and migratory birds, use protocols derived from multi-agency cooperation and thus span NFS and other agency boundaries. Heritage surveys are fairly consistent across Forests and agencies because they are based on Department of Interior standards and guidelines and National Park Service technical bulletins for compliance with the National Historic Preservation Act. A difficulty with the heritage program is that it must follow standards and protocols set by the State. Each State has somewhat different standards so consistency within a multi-State Region such as R2 is difficult. However, Regions 2, 5, and 8 are working with States to develop more consistency.

Coordination of designs: Regional inventory data generally reflect either National, Regional, or State protocols, but the purpose or application of the inventories tends to be for the project or site level. Exceptions that have some linkage from site to landscape, regional, or national scales are: vegetation (FIA - forested lands) and biophysical characterization (landtype, landtype association, subsection, section). At the Forest Plan or Regional scales, protocols guide the characterization of lands, waters, wildlife habitat, and social/economic conditions. The base data from sampling are generally not statistically linked (across scales) for these characterizations, however and the degree that protocols are consistently applied depends on the rigor of quality management practices used.

All Regions rely on a combination of mapping efforts and field surveys, but the degree of emphasis on mapped vs. field survey operations and products varies from Region to Region. Most mapping efforts appear to be centrally managed to foster consistency across forests and allow aggregation across forest boundaries. It is not surprising, however, when a map product is found to be less than consistent when put to use for broad scale assessments because of lack of tightly specified classification schemes and/or varying degrees of skill and expertise among people. The degree that map products are assessed for accuracy can vary. Where the emphasis of central management is on mapping rather than field plots using permanent plot grids, themes commonly mapped include water, existing vegetation, soils, geology and landform. Data are mapped at the landtype or association level to provide information for use at a variety of scales from the project to strategic (i.e. can be aggregated). This map information can be used in conjunction with the forest inventory plots for a variety of assessments.

Regions 5, 6 and portions of Region 10 implement field surveys based on permanent plot grids over lands managed by NFS and other cooperating federal and State areas. The measurements made on grid points are intended to be compatible with FIA in Region 5 and 6, and FHM for the Tongass National Forest in Region 10. Other Regions rely on FIA data for field surveys consistently conducted across NFS lands within the Region, and on special surveys conducted by specialists on a site-by-site or forest-wide basis. All Regions rely on FIA data for consistent information that at least partially describes the context of forest conditions on adjoining ownerships. Setting the context for non-timber attributes (such as grasslands, watersheds, and socio-economic attributes) of adjacent lands is attempted in a variety of creative ways and usually associated with specific broad-scale ecoregional assessment projects such as the Interior Columbia River Basin Assessment and Southern Appalachian Assessment.

Coordination across administrative boundaries: National inventories such as FIA show the most consistency across NFS boundaries for forested areas. FIA does not include rangeland inventories unless commissioned, as in Region 4. Rangeland inventory protocols are still pending between BLM, NRCS, and the FS.

Wildlife habitat and population inventory or monitoring tend to be guided by Regional protocols, thus sustaining some consistency across Forests, but not necessarily across Regions. Threatened and endangered species with recovery plans usually have coordinated monitoring programs. For some species, special surveys are conducted in cooperation with external cooperators including States and non-governmental groups. Sampling designs and measurement protocols are typically set by steering groups overseeing these surveys.

Aquatic inventories and monitoring are guided by protocols, but the focus is generally on stream reach surveys used for project level assessments and action. Training programs are provided by the national units for aquatics and streams, but there is limited post-training or field review to assess the degree to which Forest level aquatic biologists and hydrologists consistently apply information from training sessions.

Human census and economic data are perceived to be fairly consistent across counties and States, and are useful for some social and economic characterizations. Other indicators used vary by Region and Forest. Nomenclature for reporting units of measure for special uses and derived products from National Forests or Grasslands are fairly consistent because of common units of measure, such as MMCF or

MMBF timber volumes, AUMs, permits, etc. Recreation use is accounted for through Forest and District RVD (Recreation Visitor Day) reporting, but these are usually based on estimates not statistically sound sampling.

4. What statistical methods and analysis are being used in inventories?

Analyses and statistical methods used vary by scale, management objective, variable being measured, degree of confidence to be achieved, and reporting requirements. Linking inventories to maps and general characterizations in a scientifically sound manner is a significant challenge. The statistical rigor for many resource inventories varies, and the confidence level expected of data supporting resource decisions is not well-established. Evaluations for the bases of many decisions focuses more on having followed policy (NFMA) and procedure (NEPA) than on the degree of rigor and statistical reliability of data supporting decisions. The degree that scientific principles are the foundation for resource analysis and interpretations is usually assumed to be adequate.

Inventories are often driven by project needs rather than a systematically designed sampling scheme. Heritage resources are a good example of project-driven inventories. They are often inventories to assess effects from timber sales or activity-oriented proposals. The land base -- such as high vista points or wilderness -- usually not systematically sampled. Statistical methodologies may be used in sampling a potential heritage site, but not in a sampling design for landscape or broader scales. Other inventories similar to heritage in their orientation towards project proposals and NEPA compliance are for TES plants and animals and aquatic resources. Grid based, random, and transect sampling with fixed or variable area plot measurements are generally used where plot data are collected. For bird population inventories, stratified distance-measured point count transects are used. Forest stand exam inventories follow fixed-plot, variable-point, and expansion rules. Rangeland vegetation is primarily analyzed through multi-variate, nested frequency, and similarity methods to determine condition and trend.

Most Regions rely on advice and assistance from research programs in the selection of statistical methods and analyses appropriate to specific objectives of significant inventory efforts. Centrally managed Regional inventory programs usually have included rigorous statistical advice early in program design, and they usually seek additional advice from statisticians when new challenges arise or program designs are being revised. Large-scale ecoregional assessments usually involve statisticians throughout the life of the assessment. Most project level work is dependent upon the local level of knowledge and skill in statistics by employees, or through agreements with research or academia for statistical advice.

Analysis methods cover a broad spectrum of uses -- from site or project level inventories and analyses to general landscape characterizations and assessments.

More than 20 protocols in Region 1 focus on the latter challenge of characterizing the land, waters, etc. at broader scales. In Region 4, the concept of "properly functioning condition" has been used as a means for characterizing conditions. The Region 3 Terrestrial Ecosystem Survey (TES) embraces continuum theory and uses aerial photo interpretation to stratify landscapes for initial sample data points. Data collection follows established scientific protocols contained in National and Regional handbooks and manuals. Classification systems are utilized to categorize information within the class limits of data. Information is integrated by simultaneous sampling of ecological components and

modeling. Through direct and indirect gradient analysis, a systems approach to determining cause and effect relationships and assessing inherent ecological capabilities is established.

5. What quality assurance procedures are used?

Quality assurance procedures considered by the team included the gamut of quality management practices and methods including: vision, leadership, standards, reviews, documentation, training, and activities intended to continuously improve an inventory program. Generally, quality management philosophies and practices are most prevalent and consistently applied where clear national leadership and agency commitment exists for a program area. Examples of inventory programs where quality management is reasonably consistent among Regions include: National standards for air quality (NAAQS IMPROVE protocol and PM10), soils (NCSS), recreation use (NRUS), and watershed condition (WIN).

Quality assurance is maintained primarily through training courses and to a lesser degree certification policies (for example Silvicultural Certification includes training and testing in use of Common Stand Exam protocols and statistical methods). The degree to which national protocols are adhered to depends on the degree that national offices and Regional program managers review and take corrective action for disparities between field practices and protocols. It was not possible within the scope of this survey to determine which national protocols are more consistently applied across Regions. Information about the level of consistency across Regions for specific national standards and protocols would require review by appropriate national program managers. Reviews and technical assistance trips are done from national offices to Regions and from Regional Offices to Forests. The degree that these reviews quantify quality objectives or monitor quality practices in a quantifiable way was not clear from our survey.

An understanding of quality management practices and use of quality assurance and control techniques are most common within a Region when inventory programs have been devised serve multiple resource staffs and provide a foundation for specific surveys. The agency still has needs to develop a commonly understood basis for quality management and application of quality assurance practices to increase customer confidence in inventory data. To address quality management issues, the agency needs to identify priority programs that are most dependent on high customer confidence and designate a person or unit to devise a plan of action in collaboration with the national program managers, Regions, and Research.

National and Regional program managers have expressed interest in evaluating inventory programs through "benchmarking" quality management practices with other relevant resource management agencies or organizations. This effort would require further investigation to determine benchmark focus areas and the likelihood for a high level of commitment.

6. What connections exist between inventory designs and NRIS database structures?

Generally there is a high degree of confidence and trust that the NRIS modules under development will house inventory data currently being collected and that the NRIS development process will provide for adjustments needed for future inventories. Although NRIS Branch Chiefs are attempting to ensure that NRIS data base structures provide for the ability to record protocols used in field collections, the

approaches used vary from module to module and the ability to actively enforce use of protocols may be beyond the scope of their authority.

Field sampling and measurement practices will depend on well-managed inventory programs. Because of this there is a perception that the NRIS effort has little relevancy to inventory design, but does provide one technology to organize and process corporate data for analysis and reporting purposes. Inventory design involves both strategic and tactical considerations to implement cost-efficient technical and operational procedures to provide for contiguous coverage across ownerships -- and especially over National Forest System lands. The NRIS program leaders have instituted implementation plans at the national and Regional levels. These plans are expected to improve with future revisions and are expected to provide a forum for inventory program managers to describe how classification, sampling, and measurement protocols will be managed to ensure congruency between the descriptions of protocols in the data base and actual sampling and measurement practices in the field.

Appendix A: Questionnaire form used for Survey of Inventories across Regions 1999

INVENTORY QUESTIONNAIRE	TOPIC AREA:
REGION:	
Contact:	Program Name:
<p>Brief Description of the inventory (Staff organization, management, funding level, scope or area addressed, ownerships covered or administrative areas covered)</p> <p>Specifics for Human Dimensions: Does the inventory deal with:</p> <ol style="list-style-type: none"> 1. the quantity of the resource available for public use (supply) 2. the quality or condition of the resource 3. the public use of the resource (amount/type, etc.) 4. the value the public has for that resource and use. 5. the role/importance of the use to local, regional, national economies. 	
<p>5.1 What Business requirements of the agency are being served by the inventory? (e.g., national reporting, regional assessments, regional reporting)</p>	
How does this inventory support the Chief's Natural Resource Agenda?	
<p>5.2 How has the Forest Service Research been involved in inventory design and/or analysis of inventory data? Research Needs?</p>	
<p>5.3 What is the nature of involvement of other agencies in inventory design and/or analysis of inventory data?</p>	
<p>5.4 What classification systems are used to define data needs or stratify sampling and analysis?</p>	
<p>5.5 What principles of scale (national, regional, project) are being used in inventory design and/or analysis?</p>	
<p>5.6 What statistical concepts and methods are used in sampling design and/or analysis?</p>	
<p>5.7 How are quality management policies and procedures used in inventory program? (e.g., enabling functions, training, certification quality assurance and control, documentation, continuous improvement processes, ability to</p>	

address customer confidence in data and information)	
5.8 What coordination is done across Regions and what level of consistency of inventory design and analysis exists for inventories across administrative boundaries (between different agencies/jurisdictions, between National Forests, Regions)	
5.9 What are the existing, planned or potential linkages to NRIS database design?	
5.10 How do Regions currently use FIA sampling design and core data for Regional and Forest level analyses with an emphasis on identifying data needs unique to Regional and Forest levels not addressed by the core national data list (core list is in Appendix II of FIA Strategic Plan?	
5.11 What products result from the inventory? Types of data, reports, map products?	
5.12 What ways is the inventory used? Applications of the inventory data?	
5.13 What protocols for analysis are applied to the data that are documented and/or reviewed? What analyses are conducted but done so in ad hoc fashion with dependency on individual analysts skills?	
5.14 Implementation -- What year was the inventory implemented and to what extent have inventories been completed?	
5.15 Outlook for Inventory Program	
5.16 Issues - Are there any issues with the current inventory program or implementation?	

B: Regional replies to the Six Interest Area questions posed by IREMCG

Region 1 and Region 4: combined report follows

Region 2: follows

Region 3: follows

Region 5: follows

Region 6: follows

Region 8: follows

Region 9

Not available for this report

Region 10: follows

REGIONS 1 AND 4: SUMMARY OF THE IREMC'S SIX INTEREST AREAS

Kerry McMenus and Jack McDonald

10/12/99

1. What is the role of Forest Service Research in inventories managed through Regional Offices?

The "short answer" is that Forest Service Research and Development was involved with inventory development or analyses if the inventory effort was in need of that expertise. Surveys from 28 different program areas indicate that Forest Service Research was involved with at least 15 programs either through inventory design, review of protocols, or with analyses/interpretations. Eight responded that Research was not involved, but these tended to be programs where a complete census or asset accounting was involved, e.g., minerals, leasing, recreation facilities, and special uses. Five other respondents did not reply to this question.

The Research Station or researchers used varies by the Program area. Heritage, for example, is a later addition to the Research clientele; starting in 1993 where a research component for Heritage was added and is located in Albuquerque. Thus, four to five long term efforts are just underway. Aquatic program use of Research for inventory assistance tends to come from the Rocky Mountain Research Station in Boise; the vegetation use of Research for FIA comes from RMRS in Ogden; for rangelands in South Dakota for Robel pole sampling methodologies; and for social sciences comes leadership from the Southern Research Station.

2. How have the Regional efforts utilized FIA procedures and data?

As Mel Mehl points out in Region 2's response: Recently the Region along with Regions 1 and 4 has 'contracted' to FIA to collect all its forest inventory data using FIA sampling (grid and mapped plot) design and data collection protocols. When completed this will provide a consistent set of plot data over 4 regions (R3 has just completed the entire region) collected on all ownerships that will be invaluable for large scale assessments.

Regions 1 and 4 have not used FIA procedures to generate plot data from the grid (to supplement FIA), but have been more focused on stand exam data to meet project level needs. It was once thought (as a strategy in Region 1) that stand exam data could also serve for broader scale characterizations, however, because of budgets and the unsystematic location of stand exam plots, this has not worked out.

There has not been a lot of active use of FIA data to date because data have been more recently gathered and/or the data have not been accessible by the Forests or Region.

There is increasing interest in FIA data for use in Forest Plan revisions, however, it is felt that this data need to be coupled with vegetative mapping such as that gained from remote sensing. Mapping and data are needed for an adequate picture of vegetative conditions, distribution of cover types, landscape patterns and processes.

3. How are Regional inventory designs coordinated across scale and administrative boundaries.

Regional inventory designs generally reflect national (or Regional/State) protocols, however, the purpose or application of the inventories tends to be for the project or site level. The exceptions which have some linkage from site to landscape, regional or national scales are: vegetation (FIA - forested lands) and biophysical characterization (landtype, landtype association, subsection, section).

At the Forest Plan or Regional scales, protocols guide the characterization of lands, waters, wildlife, and social/economic conditions, however, the base data from sampling are generally not statistically linked (across scales) for these characterizations.

Regarding consistency across administrative boundaries, Nationally derived inventories such as FIA show the most consistency across NFS boundaries although consistency differs with other agencies such as NRCS in the inventories of private lands. FIA does not include rangeland inventories unless commissioned which Region 4 has done. Rangeland inventory protocols are still pending between BLM, NRCS, and the FS.

Wildlife habitat and population inventory or monitoring tend to be guided by Regional protocols, thus some consistency across Forests, but not necessarily across Regions. Threatened and endangered species with recovery plans usually have coordinated monitoring programs for the species.

Aquatic inventories and monitoring are guided by protocols, however, the focus is generally on stream reach surveys used for project level assessments and action. Methodologies vary across Forests and Regions.

Human census and economic data are fairly consistent across counties and states and are useful for some social and economic characterizations. Other indicators used vary by Region and Forest.

Heritage surveys are fairly consistent across Forests and agencies because of Secretary of Interior standards and guidelines and National Park Service technical bulletins for National Historic Preservation Act compliance.

Accounting of special uses and derived products from National Forests or Grasslands are fairly consistent because of common indicators, e.g., MMCF or MMBF timber volumes; AUMs, permits, etc. Recreation use is accounted for through Forest and District RVD (Recreation Visitor Day) reporting, however, this is based on estimation and not statistically sound sampling methodologies.

Table 1. Status and relationship of inventory activities in Regions 1 and 4. 1/

Unit	Scale	Biophysical Character	Existing Vegetation	Terrestrial Ecological Units	Aquatic Ecological Units	Human Dimensions
Nation	Ecoregion, Basin	Section	FIA/FHM			
Region	Ecoregion, Basin, Subbasin	Section, Subsection	FIA/FHM	Individual Species Monitoring		
Forest (Plan)	Subbasin, Watersheds	Subsection, Landtype Association (LTA)	FIA Stand Exam Ecodata	Protocols for Individual Habitat Models	Protocols for delineating HUCs; valley bottom segments	Protocols for characterizing Social & Economic; Recreation; Grazing/ Timber suitability; Mineral potential;
District (Project)	Subwatersheds	Landtype	Stand exams Ecodata; Noxious Weed inventories; TES Plant inventories	Individual species Habitat indices	R1/R4 Fish and Fish Habitat; Stream Reach and Hydrologic Inventory Protocols	Heritage; Special Uses; Recreation; Timber; Roads, trails, and facilities

FIA: Forest Inventory & Analysis; completed region-wide 1999.

LTA: Landtype Association Mapping and Attributes. Region 1 lands are mapped (100% complete)

R1/R4: Fish and Fish Habitat Standard Inventory Procedures Handbook INT-GTR-346

HUCs: 4th, 5th, and 6th Hydrologic Units are delineated in accordance with USGS standards for Idaho, Montana.

1/ See attached listing of protocols that have been developed.

4. Describe statistical methods and analysis methods used.

The most sophisticated use of statistical methodologies lies with the FIA vegetative inventories. Otherwise, inventories are often driven by project needs rather than a systematically designed sampling scheme. Heritage resources are a good example of project-derived inventories. Their inventories are often done to assess effects from timber sales or activity-oriented proposals. The land base such as high vista points or wilderness are not systematically sampled. Statistical methodologies may be used in sampling a potential heritage site, but not used in a sampling design for landscape or broader scales. Other inventories similar to heritage in their orientation towards project proposals and NEPA compliance are TES plants and animals and aquatic resources. More recently with ecosystem management and emphasis on restoration, inventories have been done up front and used to propose restorative projects. Resource inventories in this vein are hydrology/fisheries, fire management, and vegetation with focus on ecological conditions.

Analysis methods cover a broad spectrum of uses...from project level analyses to broader scales. Generally, it seems that we have 1) site or project level inventories and analyses; and 2) general landscape characterizations and assessments. More than 20 protocols in Region 1 focus on the latter challenge of characterizing the land, waters, etc. at broader scales. In Region 4, the concept of "properly functioning condition" has been used as a means for characterizing conditions. As example, the vegetative characterization has included **time** (past (historic range of natural variation, potential), current, and future (vegetative simulation models such as SIMPPLLE or LANDSUM)). **Spatial orientation** is also important with the vegetation and with other resources; similar to R2's application of IRI mapping. Focus recently for vegetation (and wildlife habitat) has been the use of remotely sense mapping.

A primary challenge that remains is to link inventories to maps and general characterizations, i.e., to make meaning of data, in a scientifically sound manner.

5. Describe quality assurance procedures used.

Quality assurance procedures vary by program area and range from 1) inventories being conducted by professional experts; 2) training; 3) Regional or National protocols for inventory methods or design; and 4) review (informal or formal) for consistent and accurate applications.

Where inventories are fully designed and standardized such as FIA, all of the four procedures above are employed for quality assurance. More commonly, however, are programs that rely on Forest professionals and offer some oversight or training with inventory procedures. Regional or national protocols are becoming more common, but the rigor or specificity of the guidance varies from national reporting requirements such as MAR targets to specifying the use of particular methodologies. Fewer have follow-through or review of inventory applications. A possible reason for less review or audit is that many inventories are not used rigorously across scales (as FIA is). Heritage program is an example of review or audit at national scales with the President's Advisory Council on Historic Preservation and State SHPO offices.

6. Describe connections between designs and NRIS database structures.

NRIS is one part of the overall Corporate data system. INFRA and other agency systems are also a part. The Program areas recognize their data as going to one of these systems....NRIS, INFRA, Heritage (TES Plants) data bases, REIS, etc. This survey did not get into the particulars as to how the program area inventories connect with NRIS. It seems that many respondents assume that NRIS will contain their data and can point to which module will contain their data, e.g., Terra, water, FSveg, fauna, human dimensions.

How the data base structures will function for retrieval and analyses seems beyond what most respondents are thinking of at this point in time. In fact, (in my opinion (KM)) many respondents basically think of their current inventory as a given (few concerns about it's design and whether it can perform at various scales) and thus, the question re: NRIS is just, "Will I be able to dump my inventory into it?"

INTERMOUNTAIN & NORTHERN REGION PROTOCOLS

FOR

LANDSCAPE ASSESSMENTS AND FOREST PLANS

April 1999

TOPIC AREA	Date	Who	Inventory & Monitor	Assessments	Decision-making
PLANNING					
Forest Planning Framework	4/99	R1/R4		AMS	X
Communication Plan for FP revision	4/99	R1/R4			X
Monitoring - WO Expectation	3/99	WO	X		
Records Management	12/97	R1			X
R4 Desk Guide	9/98	R4			X
Landscape Assessments Guide	9/96	R1		X	
EAWS Guide		R6		X	
Subbasin Review Guide - Draft	99	CRB		X	
BIOPHYSICAL					
Landtype Association	8/97	R1	X		
Valley Segment Characterization	97	R1	X		
VEGETATION					
Potential Natural Vegetation Guide	97	R1	X	X	
Vegetation Response Units	97	R1	X	X	
Current Vegetation Data/Map	97	R1	X	X	
Old Growth	97	R1	X	X	
Rare and Unique Habitat	97	R1	X	X	
Dead and Down Components	97	R1	X	X	
Structural Stage Classification	97	R1	X	X	
Pattern and Process Assessment	97	R1	X	X	
Reference Conditions	97	R1	X	X	
Fire Processes	97	R1	X	X	
Insect and Disease Processes	97	R1	X	X	
Influence of Climate	97	R1	X	X	
Herbivory Processes	97	R1	X	X	
Physical Processes	97	R1	X	X	
Exotic Species as a Process	97	R1	X	X	
SIMPPLLE Model	97	R1	X	X	

TOPIC AREA	Date	Who	Inventory & Monitor	Assessments	Decision-making
AQUATIC					
Water Quality	4/99	R1/R4		X	X
Aquatic Unit Delineation	6/98	R1	X		
HUCs - Mapping and Digitizing	95	NRCS	X		
Watershed Characterization	1/96	R1		X	
Watershed Condition - Coarse filter	11/97	R1		X	
Aquatic Map Layers	10/96	R1	X		
WILDLIFE					
Viability Approach	4/99	R1/R4		X	X
Terrestrial Protocol					
Coarse Filter	3/97	R1		X	
Species at Risk	3/97	R1		X	
Viability	3/97	R1		X	
Connectivity	3/97	R1		X	
Information Base, Models, etc	3/97	R1	X	X	
SOCIAL AND ECONOMIC					
Social Assessment Protocol	6/97	R1		X	
Land Settlement Patterns	97	R1		X	
Sense of Place	97	R1		X	
Fed. Trust Responsibility & Tribal Rights and Interests	97	R1		X	
Economics Advice	4/97	R4		X	
Economic Variables & Assessment					
Budget	97	R1		X	
Current Economic Environment	97	R1		X	
Impacts	97	R1		X	
Economic Efficiency	97	R1		X	
GOODS AND SERVICES					
Access and Travel Mgt	99	R1/R4		X	X
Access - Legal Access	8/98	R1		X	
Access to R4 National Forests	7/98	R4		X	
Grazing	2/97	R1		X	
Recreation	12/97	R1		X	
Roadless Area Inventory and Eval.	5/98	R4		X	
Roadless Area Inventory	11/96	R1		X	
Road Data Protocol	7/97	R1	X		
Scenery Inventory & Integration	6/97	R1		X	
Special Uses - Addressing in FPs	2/23/99	WO			
Wild and Scenic River	6/96	R1		X	

Wilderness	4/98	R1		X	
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REGION 2 SUMMARY OF THE IREMCG'S 6 INTEREST AREAS

Mel Mehl

10/2/1999

1. What is the Role of Research in inventories managed through the RO?

The role of research has been limited in all the resource areas except Forest Inventory and air and water quality. Research assisted in the development of data design and collection protocols for the air and water program. Research, specifically FIA has always been involved with the Regional Forest Inventory program, providing advice and assistance in data collection protocols and sampling design.

Most over involvement has been through resource staff making use of station papers and reports or asking research to review proposed inventory schemes. Generally Research projects are not aimed at answering management oriented inventory questions, especially those of a spatial nature but border on 'pure' research which generates appropriate publications by which most researchers are recognized for achievement.

2. How have the Regional efforts utilized FIA procedures and data?

The RF and Station Director are required by FSM to provide coordination as the Region provides NFS data for RPA. In the past we have not utilized FIA data that much as we collected 'our own' data but to FIA standards at the time. Also we increased the sampling intensity considerably over what FIA would have done. So FIA data was on other ownerships. However now with GIS capability we are looking to using FIA data on other ownerships with our own data for large scale assessments.

Recently the Region along with Regions 1 and 4 has 'contracted' to FIA to collect all it's forest inventory data using FIA sampling (grid and mapped plot) design and data collection protocols. When completed this will provide a consistent set of plot data over 4 regions (R3 has just completed the entire region) collected on all ownerships that will be invaluable for large scale assessments.

Plot data is used to provide average vegetation characteristics for individual strata. Plot data is also used to model (FVS) a variety of potential vegetation treatments to determine ASQ for the forest plan.

3. How are Regional inventory designs coordinated across scale and administrative boundaries.

Generally all regionally sponsored inventories including forest inventory, stand exams, rangeland an etc. are implemented consistently across the Region. But most of the inventory data collection is in NFS ownership except for a few partnership programs.

Recently the Region along with Regions 1 and 4 has 'contracted' to FIA to collect all its forest inventory data using FIA sampling (grid and mapped plot) design and data collection protocols. It is anticipated that the plot data collected on the grid will need to be supplemented to provide adequate samples for individual forest planning needs.

In 1993 the Region implemented an Integrated Resource Inventory (IRI) mapping effort. This effort will be consistent across all forests allowing for the ability to provide information across forest boundaries. Three themes are being mapped, Water, Existing Vegetation and Soils, geology and landform. Mapping is being done at the landtype or association level providing information for use at a variety of scales from the project to strategic (i.e. can be aggregated). This map information can be used in conjunction with the forest inventory plots for a variety of assessments.

Specific resources inventories such as heritage program, air and water, soils (protocols followed by IRI), water systems, migratory birds use protocols derived from multiagency cooperation and thus span NFS and other agency boundaries.

A difficulty with the heritage program is that it must follow standards and protocols set by the state. Each state has somewhat different standards so consistency within a multi state Region such as R2 is difficult. However, some work is being done with R5, R8 and R2 to work with the states to develop more consistency.

4. Statistical methods and analysis used?

Generally grid based, random, and transect sampling with fixed or variable area plot measurements are used where plot data is collected. For bird population inventories, stratified distance-measured point count transects are used. The Region's IRI project does not use sampling since it's a map based effort.

5. Quality assurance procedures?

For forest inventories, FIA procedures are being followed 100%. Collection of soils data follows NRCS protocols and Q/A requirements. Other programs have training or user guides and provide training as needed and reviews of work periodically. In addition some inventory work is 'done' via contracts which have specific error limits and inspection rates.

6. Connections between designs and NRIS database structures.

Stand exams will follow the protocol developed for FSveg. So far FSveg is the only module that has developed a common inventory protocol for its data. NRIS is developing a repository and standard inventory protocols later. But basically most of the data being collected will have a place in NRIS although it was not collected originally with that in mind. Some of the data collected through partnerships such as the Colorado Birds 2001 inventory is stored by another group and will not go into NRIS.

REGION 3 SUMMARY OF THE IREMG'S 6 INTEREST AREAS

provided by Wayne Robbie

1. What has been the role of Forest Service research in inventories managed through Regional offices?

The Southwestern Region has a long standing active partnership with Rocky Mountain Research Station and in particular, the labs that are located in Albuquerque and Flagstaff. Through time, past and present individual researchers have been directly engaged in resource inventory design, implementation and quality assurance. Their involvement is specific to individuals' areas of expertise and as needed or solicited by resource function and discipline. Researchers from local universities and colleges are also under contract or through general agreements involved with inventory activities.

Specific resource areas where research is involved includes forestry, range, cultural resource, watershed and ecological unit inventory (Terrestrial Ecosystem Survey). Their role in resource inventories is to advise and participate in establishing protocols (methods), sample design, data collection, analysis and interpretation. Research also assists in the processing of inventory publications and other forms of media for communication and training.

Depending upon availability and interest, research personnel participate in field reviews to assist in providing quality assurance. They are actively engaged with the ecological unit inventory and are relied upon to assist in the calibration and correlation process to maintain consistency and uniformity between field going scientist within and between units.

The Forest Inventory and Analysis unit of the Rocky Mountain Station has been under contract with the Region to conduct a grid sample inventory of woodlands and forest for the past four years. This project was completed in FY 1999.

2. How have Regional efforts utilized Forest Inventory and Analysis (FIA) procedures and data?

The Southwestern Region has contracted with FIA to complete an existing vegetation survey for forests and woodland over the last four years at a cost of approximately 3.0 million dollars. Information from this inventory is slowly becoming available and will be utilized once data summaries are completed by Forest. This is expected in FY 2000.

Forest inventory and analysis procedures have not been utilized outside the scope of the inventory and as yet have not been integrated into other resource inventories or surveys. This is due to the reason that FIA procedures are directly tied to their sample design, and this design emphasizes broad strategic analysis. Regional inventories and surveys have sample designs and protocols that are directly linked to management objectives, scientific principles, regional standards or guidelines, and a spatial (map) base suitable for Forest, District, watershed or allotment analysis. Since FIA inventory does not provide a map, their information will be integrated with stand exams and ecological units to enhance it's utility and determine how representative the grid sample point is relative to other resource inventory data points and ecological classification systems to compliment one another and ensure integrity of interpretations for the appropriate scale and level of decision.

Immediate application of FIA data for the Southwest is directly tied to macro-monitoring of Mexican Spotted Owl habitat. Two levels (macro and micro) of monitoring are being implemented at the landscape and project scale. FIA data will support change detection spatial analysis being conducted with remote sensing technology.

Workshops are being considered to familiarize Forest and District personnel on how to utilize FIA data for landscape and Forest level analysis.

3. Describe how Regional inventory designs are coordinate across scales and administrative boundaries.

The Southwestern Region went through an exercise involving reinvention during 1995. As part of that effort a committee was formed which evaluated existing inventory and monitoring activities. The team was comprised of resource program leaders from each staff who maintained responsibilities for any activity related to information acquisition which included inventory and monitoring.

As a result of reinvention and the work assessment activity for inventory and monitoring a Regional Ecological Inventory Coordinator and Regional Monitoring Coordinator positions were established within the Ecosystem Analysis and Planning/Watershed and Air staff unit.

The coordination of inventory and survey activities is accomplished through deliberate interaction between resource staffs. Changes in resource inventory procedures or schedules are communicated to the Ecological Inventory Coordinator. The Southwestern Region, Regional Leadership team fully supports and continues to invest in both strategic (FIA) and management (EUI-TES; stand exam, rangeland) based inventories. They recognize the long-term benefit and added value of maintaining information acquisition. The Region has taken a centralized approach to managing and conducting most inventories. This approach involves both administrative and technical support for data base management, some operational activities and training.

Table 1. Status and relationship of inventory activities in Southwestern Region.

Unit	Scale	Existing Vegetation	Terrestrial Ecological Units	Aquatic Ecological Units	Fuels
Region	Ecoregions	FIA	GTES	GFES/GLES	
Forest (Plan)	Landscape/Watersheds	FIA Stand Exam Range Analysis	TES TES	GFES/GLES	Farsite
District (Project)	Land Units/Subwatersheds	Stand exams Range Analysis RASES	TES	RASES NWI	Farsite

FIA: Forest Inventory & Analysis; completed region-wide 1999.

RASES: Riparian Area Survey and Evaluation System (scale: 1:6000-1:24000)

GTES: General Terrestrial Ecosystem Survey (scale 1:250,000), completed region-wide

TES: Terrestrial Ecosystem Survey (scale 1:24000), 78% of region completed

GFES: General Fluvial Ecological Survey (scale 1:250,000), completed region-wide

GLES: General Lacustrine Ecological Survey (scale 1:250,000), completed region-wide

NWI: National Wetland Inventory (scale 1:24000)

4. Describe analysis and statistical methods used.

Analysis and statistical methods which are used vary by scale, management objective, variable being measure, degree of confidence to be achieved and reporting requirements.

Forest stand exam inventory follow a fixed plot, variable point and expansion rules. The database Rmstand is based on FORTRAN. The Region is moving to the common stand exam procedure.

Forest inventory and analysis procedures follow statistical analysis system (SAS) procedures for data collected on a 5,000 meter square grid.

The Terrestrial Ecosystem Survey (TES) embraces continuum theory and uses an aerial photo interpretation to stratify landscapes for initial sample data points. Data collection follows established scientific protocols contained in National and Regional handbooks and manuals. Classification systems are utilized to categorize information within the class limits of data. The process of integration is performed by simultaneous sampling of ecological components and modeling. Through direct and indirect gradient analysis a systems approach to determining cause and effect relationships and assessing inherent ecological capabilities is established.

Rangeland vegetation is primarily analyzed through multi-variate, nested frequency and similarity methods to determine condition and trend.

It should be noted that the statistical rigor for many resource inventories varies and the confidence level of resource managers to make decisions is based more on following policy (NFMA) and procedure (NEPA) with the assumption that scientific principles are the foundation for resource analysis and interpretations.

5. Describe the quality assurance procedures used.

Quality assure procedures are implemented in most Regional inventory activities through formal and informal review and audits. Adequate training is the basis from which quality information is collected and processed.

The FIA contracted inventory provided quality assurance in-house, meaning they have a dedicated team that checks a certain percentage of plots to ensure reliability and accuracy.

The ecological inventory program has a formal, annual review process which involves Regional office, Research, Forest, District, and interagency personnel. Field and office reviews are scheduled with specific objectives to ensure compliance with Regional standards and protocols as outlined in handbooks and manuals. Emphasis is placed on calibration of scientists for protocols and methods; an evaluation of and correlation of ecological types and units to maintain standardization and uniformity between inventory teams and across forest boundaries, consistency and repeatability of measurements.

Workshops are held on an annual basis to train inventory personnel and users of inventory data. These training sessions for rangeland and ecological unit inventories address changes including updates in forms and procedures. Additional workshops are given in the Southwest to train users on the limits and application of the data and information, so that analysis and interpretations are within the scope (integrity) of the data and its use is appropriate for the scale (context) through which it was collected.

6. Describe the connections between inventory designs and NRIS data bases.

In the Southwestern region all present and future inventory information will be processed by the various NRIS modules. The past, present and future inventory designs are appropriately related to funding, skills, technology and operational schedules to meet planning and monitoring requirements. NRIS data base structures have little relevancy to inventory design, but do provide one technology to organize and process corporate data for analysis and reporting purposes. Inventory design involved both strategic and tactical considerations of program management to implement technical and operational procedures in cost efficient and progressively effective approach for contiguous coverage across National Forest System lands.

The relationships between NRIS modules and inventory programs is outlined in table 2. There are very direct connections and each program area is linked to NRIS modules through identification, collection and, processing of corporate data elements.

Table 2. Relationship of National Resource Information Systems (NRIS) data modules and R3 inventory programs.

NRIS Data Module	R3 Inventory Program
Air	Air Monitoring Program
Fauna	Bison, R3 HARE
FSVeg	Rmstand, common stand exam
Terra	Rangeland analysis, Terrestrial Ecosystem Survey, RASES
Water	RASES, T-Walk, Stream health WUTS
Human Dimensions	Cultural resource surveys, demographics

**Region 5, Pacific Southwest Region
provided by Ralph Warbington**

October 1999

1. Involvement of Forest Service Research:

Region 5 has involvement with two Research Stations; Pacific Southwest Station, and Pacific Northwest Station. PSW has been actively involved with Region 5 in wildlife demographic studies for Northern and California Spotted Owl, martin and fishers and other terrestrial wildlife species. PSW has also been actively involved with the Region in soil productivity studies, vegetation control and growth and yield model developments. Since PNW has the overall responsibility for Forest Inventory in California, the areas of forests sampling and inventory have been coordinated through them. PNW has been involved in the statistical procedures and sample design of the current FIA grid system in Region 5 as well as defining the grid sample framework and plot locations on NFS lands. Consultation is ongoing with implementation of the FIA grid plot system and proposed re-measurement cycle to meet the annualized inventory requirements.

2. How Regional efforts utilize FIA procedures and data

Region 5 has utilized the FIA procedures developed by PNW for all its current NFs inventories, and those in progress for plot sample design and locations. Region 5 installs the FIA grid on NFs lands for meeting the 3.4 mile grid requirements. These plots are augmented with additional plots (intensification of 1.7 mile or .85 mile grid plots) for rare populations of vegetation types on each Forest in order to meet the requirements of LMP for forest yield tables, wildlife habitat assessment and modelling and forest health and monitoring. The FIA 3.4 mile grid plus additional plots are used in conjunction with an existing vegetation map to make statistical estimates of various vegetation conditions or strata populations on a National Forest.

The Region also has used NFS grid plots as well as FIA grid plots on private land to conduct vegetation map accuracy assessments across large ownerships on over 30 million acres in California.

3. How Regional inventory designs are coordinated across scales and administrative boundaries

Most of Region 5 inventories used for Land Management Planning or Bioregional Assessments have been coordinated across scales and admin. boundaries. Example of this are existing cooperative existing vegetation, wildlife habitat, surface fuels, and fire history mapping program exists using a common standard for minimum mapping units and classification systems shared throughout all National Forests, State and Private lands; Ecological Unit Inventory for Section and Subsections have been map throughout California through in cooperation with NRCS and the FS. Order 4 EUIs have been conducted on Southern Sierra Province and are planned for the Southern California Province Forests using the R5 EUI data base standards. Order 3 and 4 soil resource inventories are completed for all National Forests in Region 5 at a 1:24,000 scale and meet NRCS National Standards as a shared mapping tile in their system. Currently soil attributes for all NFs mapping tiles are being entered into the NRCS National Soils data base by a FS contractor working on-site in NRCS Davis Office. Region 5 is working with USGS on getting geology maps into GIS

coverages shared across ownerships, and provided vegetation coverages as inputs into USGS land use land cover mapping project. Vegetation inventory and stand exam protocols are standardized across the Region using the Region 5 FIA Users Guide, protocols, data recorders and FIAS software.

4. Statistical methods and analysis used

Region 5 follows standard statistical sampling methods in forest inventory and stand exams, map accuracy assessment methodology and procedures, ecological classification plots and analysis procedures outlined in Region 5 handbooks and user's guides. These systems and analysis methods have been developed in concert with Research Stations and Universities and are consistent with current WO directions.

5. Quality assurance procedures

For Region 5, quality control and quality assurance procedures are in place for inventory programs through the use of professional services contractors, contract specifications, acceptable accuracy tolerances, contract inspections, crew certification, training of NFs employees in inventory methods and protocols, use of GPS technology for spatial accuracy, standard scales of mapping tied to 1:24,000 scale maps or others specified scales if appropriate, Regional Handbooks and User's Guides, GIS data dictionary and meta data along with standard software tools and data bases.

6. Connections between inventory designs and NRIS database structures

Region 5 has developed an implementation plan to migrate existing GIS and related data sets into NRIS data base structures. This will be accomplished using loaders designed to move standard R5 data sets to National standards. Examples are FIAS data sets for inventory and stand exams into NRIS FSVEG, EUI inventories of various orders from R5 EUI oracle data base to NRIS TERRA, and Order 3 and 4 Soil Resource inventories from NRCS data base to NRIS TERRA. Once migration of common R5 data sets are completed, our plan is to use National tools or modify existing software tools to load new information directly into NRIS.

Region 6, Pacific Northwest Region
provided by John Teply
September 30, 1999

Region 6 has sponsored or managed four inventory programs through the Regional Office for several years, each program for a different number of years. These programs are: the ecology classification program, the soil classification and mapping program (more recently known as the ecological unit inventory), the stream inventory program, and the current vegetation terrestrial inventory and monitoring program. The following describes how these programs are related to your defined interest areas.

1. Involvement of Forest Service Research:

- Ecology program: The area ecologists were all PhD ecologists and while they did not directly involve the local research stations with their design and analysis, they did utilize research ecologists in the review of their completed classifications.
- Soil mapping and classification: This program implemented the protocols developed by NRCS and often directly contracted with NRCS to do the soil mapping.
- Stream inventory: stream inventory protocols were developed by research and implemented by field specialists on a site basis. Currently working with the Statistical Advisory Group established by the current veg inventory to enhance the utility of their estimation capability.
- Current vegetation inventory: the sample design and plot design was developed under the guidance of 3 research stations, which included 2 FIA units and originally 2 agencies but now 3 agencies. The information acquired and the protocols used were the result of direction from silviculture, wildlife, ecology, fire, sales, insect and disease and planning.

2. How Regional efforts utilized FIA procedures and data.

- FIA's focus of tree condition of forested non-NFS land has not provided these programs with a significant amount of assistance. The current veg inventory has repeatedly linked variables and protocols to assure compatibility.

3. How Regional inventory designs are coordinated across scales and administrative boundaries.

- The ecology program (now dropped as a Regional program) acquired data for the purpose of classification by zones with coordination between zones which eliminated the question of boundaries within NFS lands. There are now efforts to extend the ecology classification effort to other federal land management agency lands.
- The soil mapping or EUI is done by defined land area and is limited to that land area until adjacent areas are also mapped. Since NRCS protocols are totally followed, cross boundaries have not been a problem.

- The stream inventory was originally implemented on a site by site basis and was thus limited to that site. Recently the stream inventory program is working on protocols (with several statisticians) to implement a sampling protocol to obtain greater strength from their inventory efforts.
- The current veg inventory initially established a UTM grid system across the states of Oregon and Washington in coordination with the PNW-FIA unit. This grid layer was then intensified by a factor of 4 and intersected with the forest boundary layer which allows the region/forests to totally post group the plots in any groupings they so desire, since the grid is across the 2 states independent of forest boundaries.

4. Statistical methods and analysis used.

- The statistical and analytical protocols used by the ecologist were developed by academia and research for the development of classifications.
- The soils and mapping efforts are directly driven by the protocols defined by NRCS.
- The stream inventory analytical process is defined by research and is now being expanded by the Advisory Group along the lines defined by the EPA.
- The current veg inventory uses both classical and non-classical statistical analysis which is necessary to accommodate the potential of unequal weighting of plots due to the various potential mapping stratifications. All such estimation protocols are and have been defined by the Advisory Group.

5. Quality assurance procedures.

- The quality assurance procedure used by the ecologists were self imposed since each zone ecologist gathered their own data, analyzed the data and developed the classifications which were then critically reviewed by the other zone ecologists and research.
- The soils mapping effort strictly follows all protocols defined by NRCS.
- The stream inventory is just implementing a new quality assurance procedure across all forests and will be streamlining the protocol from the forest level to a zonal level for the sake of consistency and economy.
- The current veg inventory program has a completely defined procedure for quality assurance starting from the actual data acquisition thru the validation process with cross checks for the summaries.

6. Connection between inventory designs and NRIS database structures.

- All inventory efforts funded through the regional office are totally compatible with NRIS and the Stream inventory and Soils inventory were used in the development of those modules of NRIS.

**Region 8, Southern Region
provided by David Meriwether**

1. What is the role of Research in inventories managed through the RO?

Support applications and interpretations

FIM is a Research program that the NFS uses

Research assisted in developing some classifications used and develops interpretations for habitat, forest health and other needs.

Research participated in design of the inventory

Participated in design, review results and assist with adaptive management

2. How have the Regional efforts utilized FIA procedures and data?

In Region 8 FIA is a source of basic resource information for forest planning and vegetation monitoring, regional assessments, and for cooperative work with State Foresters who are primary partners. R8 uses both the Core and Non-core FIA Variables and FIA provides increased sample intensities on some Forests. We use FIA data for monitoring forest cover across the region and forests, including NF and other ownerships, growth & yield projections for determining allowable cut and economic effects of Forest Plans. The old, periodic state level inventories provided point-in-time data that became less useful several years after the inventory was completed. New, annualized inventories have been initiated in 7 states and 11 more by the end of FY2000. This procedure will provide data for continuous monitoring while meeting periodic planning needs as well. There is strong support from NFS and State Foresters in Region 8 for the new FIM program. NFS supports sampling on NFs with NFIM funding (\$350K in FY2000) and some states provide funding or staffing for field crews.

3. How are Regional inventory designs coordinated across scale and administrative boundaries?

Limited design coordination across scales and administrative boundaries is done. Traditionally, NFS inventory work has been designed for the purpose of supporting field level needs, such as stand exam and other site level inventories. FIA data has been crosswalked with stand level inventories on the national forests and summarized for use in forest planning, but classifications used are not totally compatible. The Landbird Survey is a strategic level inventory that uses a stratification of stand level data for plot and location, as well as application of the data for habitat interpretations. Terrestrial ecological unit inventories are well nested between scales down to the landtype association level, and can be used for interpretations across national forest boundaries. None of the NFS inventories collect data outside the national forests.

4. Statistical methods and analysis used?

No mandatory statistical tests are prescribed regionally. Stand exam utilizes a "rule-of-thumb" design for sample design. The Landbird Survey calls for stratified random sampling and consultation with a biometrician using local data sources in determining sample size and design.

5. Quality assurance procedures?

Regional standards have been established for 12 core GIS layers, stand exam, migratory and resident landbirds surveys, and red cockaded woodpeckers activity surveys. National standards for air quality (NAAQS IMPROVE protocol and PM10), soils (NCSS), recreation use (NRUS), watershed condition (WIN) are applied. Primary quality assurance is done primarily through training, certification, program reviews, and functional assistance visits.

6. Connections between inventory designs and NRIS database structures?

For Region 8, there is generally no direct connection between existing inventory designs and NRIS database structures. Indirectly, data elements collected in regionally and even most locally designed inventories will fit with the NRIS data definitions and into the NRIS data structure. We expect that regional data entry and interpretation applications will be needed to fit the unique inventory approaches of the region and the special data interpretations, such as for specific TES species.

Region 10, Alaska Region provided by Dave Ellen

1. Involvement of Forest Service Research

Scientific credibility, a major objective of the Alaska Region's information strategy, leads the Region to major collaboration with Forest Service Research. To do this, the Region negotiates formal partnerships with local and national units of the Forestry Sciences Laboratory and documents them with MOUs (Memoranda of Understanding). These agreements, which include a work plan and financial plan, are updated annually.

Some examples:

A. Permanent Plot Grid Inventory

A master Memorandum of Understanding between the Region and the Pacific Northwest Research Station serves as an umbrella for specific areas of common interest, including:

- a) Tongass Administrative Studies,
- b) Science input to the Chugach NF Forest Plan Revision,
- c) The Permanent Plot Grid Inventory.

A team of scientists from the Forestry Sciences Laboratory working hand-in-glove with Regional experts completed the Tongass National Forest Plan. This effort involved inventories and other data collection in many modes, including field data gathering, remote sensing, public involvement, and so forth.

B. Inventory of Inventories

An Inventory of Inventories identified 262 monitoring, inventory, and administrative study efforts in the Region. This study identified duplication of effort, lack of standardization, and lack of coordination.

A Review team acting on the findings of the "Inventory of Inventories" recommended among other things that the Region re-engineer the process of identifying and involving partners in data acquisition. The Region then sponsored a national Natural Resource Information Integration Workshop in December 1998. A major purpose of this workshop was to identify partnership opportunities with other agencies. The workshop was well-attended by representatives from Forest Service Research, representatives from State agencies, and other Forest Service Offices.

As a direct result of this workshop, the Region identified eight specific action plans designed to meet the Ecosystem Management Information Integration Strategy through ECOMAP, Existing Vegetation Classification and Mapping, Decision Support Tools, NRIS Terra, NRIS Water, NRIS FSVEG, NRIS Fauna, and NRIS Human Dimensions.

These action plans will formalize interagency partnerships, and establish MOUs (Memoranda of Understanding), and partnership agreements with other agencies. When fully implemented, the action plans will have an implementation schedule, with measures for tracking progress, completion, and accountability.

2. How Regional efforts utilize FIA procedures and data

Through the provisions of an MOU, the Forestry Sciences Laboratory Anchorage FIA unit designed the Alaska Regional vegetation inventory (Permanent Plot Grid). The Regional Inventory Specialist participated in the design to assure that Regional needs were being met. The resulting design is consistent with Forest Health Monitoring procedures, meets RPA requirements, and has the statistical intensity needed to support future Forest Planning efforts.

The Region and the Anchorage FIA unit leverage data-collection dollars by collaborating on the Permanent Plot Grid. FIA personnel conduct all fieldwork, regardless of ownership. In addition to distributing fixed costs over a broader base, this arrangement assures the Permanent Plot Grid will adhere to identical standards. The ?Grid? uses the same statistical rigor, follows the same procedures, uses the same handbook, and has the same expectations whether a particular sample happens to occur on national forest land or on some other ownership.

The Permanent Plot Grid project gathers vegetation cover data, soils data, wildlife observations, and conducts a goshawk survey at the inventory points. These items are available for Regional analysis. The data will eventually be stored in appropriate NRIS modules.

3. How Regional inventory designs are coordinated across scales and administrative boundaries

A. Permanent Plot Grid

The Permanent Plot Grid sample array in the Tongass National Forest region is distributed on a 4.8 kilometer grid containing over 4000 four-point clusters that are patterned after the Forest Health Monitoring plot design. Of the 4000 clusters, about 3000 reside on national forest land, with the balance on State of Alaska, municipal, corporate, other federal, and private lands. A similar plan for the Chugach National Forest inventory is in force.

Permanent Plot Grid sample locations are indistinguishable from each other, and often the field crew does not even know whether the landowner is the national forest. Analysts can include or exclude any sample on the basis of ownership (or any other characteristic) without fear of bias. This may provide a significant long-term payoff. Two entire ecological provinces are represented.

B. Existing Vegetation Classification and Mapping

The Region plans to develop a hierarchical classification that spans the full range of forest types from seral to climax as well as shrub- and herbaceous-dominated communities. To complete this task, the Region plans the following:

- a. Populate Terra with R10 ecological data and evaluate current cluster groups
- b. Develop classification keys
- c. Develop community type descriptions
- d. Map within GIS
- e. Publish results and findings

An interregional USFS effort to delineate the upper four levels of the hierarchy for Terrestrial Ecological Classification and Mapping (ECOMAP) culminated in a unified map showing Domains, Divisions, Provinces, and Sections. Alaska Region released its latest ECOMAP version in February, 1995.

ECOMAP is serving as an interagency platform for ecosystem management and the sharing of ideas and ecological information.

4. Statistical methods and analysis used

A. Permanent Plot Grid

The Permanent Plot Grid design is a one-phase systematic-sample without stratification. Mensurationist Willem van Hees of the Anchorage FIA office uses methods described in "Estimating Forest Attributes Using the Mapped Plot Design," (Zarnoch and Bechtel, Mathematical Statistician and Research Forester, respectively, Southern Research Station, Asheville, NC, in preparation) to analyze the data. Estimates for the compilation phase follow a "bootstrap" approach recommended by Mathematical Statistician Tim Max of the Pacific Northwest Experiment Station.

B. ECOMAP

Regional ECOMAP specialists use ecological classification analysis tools and techniques.

5. Quality assurance procedures

A. Permanent Plot Grid

Quality for the Permanent Plot Grid is assured by using the best available people and giving them the best possible training. A "Grid" field crew consists of two people: a botanist skilled in plant identification and a forester skilled in tree measurements. Each field season is preceded by a two-week training session during which all new examiners are introduced to Forest Service procedures and trained in the "Grid" techniques. Examiners with previous experience on the Grid are given a one-week refresher. About

two-thirds of the fourteen people employed each field season have previous experience, assuring a high degree of continuity and consistency from year to year. To the extent possible, an experienced person is paired with an inexperienced person.

Three highly skilled people experienced in plant identification, sampling, and aerial photo interpretation, supervise the Permanent Plot Grid fieldwork. They accompany field crews on new work to continuously improve examiners' skills. Supervisors make regular inspections of completed work to establish the quality of work actually achieved.

The Project Leader of the Anchorage Forestry Sciences Lab, a Research Forester, provides overall supervision of the field and analytical work. This project is widely regarded by all concerned as one of the best-run projects of any kind they have ever been associated with.

A Regional Inventory Specialist participates in all phases of the Permanent Plot Grid to assure that Regional needs are met. A Regional Information Resource Manager provides overall guidance.

B. R10 NRIS Implementation Plan Quality Assurance Procedures

The Resource Information Officer will lead a region-wide Quality Assurance Team made up of Forest Inventory Coordinators, Forest Monitoring Coordinators, Data Stewards, NRIS Module coordinators, a PNW statistician, and a cross section of program managers to develop a scientifically credible quality assurance process.

Inventories will use accepted peer-reviewed protocols. Each field data collection effort will complete an Inventory Design Report addressing the following:

- a. Project Objective
- b. Responsibility assignments
- c. Issues or Management Questions
- d. Description of design protocols and products.
- e. Timeline with benchmarks
- f. Funding requirements and sources
- g. Partnerships
- h. MAR category and proposed target

6. Connections between inventory designs and NRIS database structures

A. Permanent Plot Grid Inventory

The ability to store, retrieve, and reuse data has been a long-standing Regional objective preceding both NRIS and its predecessor CSDS. As a result the Permanent Plot Grid inventory was designed to connect directly with NRIS. Virtually all collected ?Grid? data elements have appropriate NRIS addresses. Most of the data is appropriate for FSVEG, and some is appropriate for TERRA.

B. Vegetation Polygon Inventories

Existing vegetation polygon inventories and ECOMAP are designed for TERRA storage using national standards. Terra has been installed on the Chugach National Forest and is scheduled to be installed on the Tongass National Forest. The Region plans to complete the installation process by FY2001. Currently, the Region is training several resource specialists to use Terra, is migrating a number of data sets into Terra, and evaluating the ability of Terra to help us manage information and make resource management decisions.

C. Stand Examinations

Loaders to prepare Superstand data for storage in the FSVEG database are under development, as are unloaders that will help analysts to retrieve data. Legacy data collected with Superstand will be stored if it meets minimum standards. The Region will store only stand exam data that has a Geo-reference (that is, we can fix the location of the measurements within a minimum standard), and meets other quality standards.

D. Silviculture Information System

The Silviculture Information System is an activity database. It has some data that may be appropriate for either FSVEG or Terra.

E. Juneau Forestry Sciences Lab Data

The Forestry Sciences Lab (FSL) collects vegetation data for its research projects. Because the data FSL collects is designed to answer a specific research question, it is not always suited to a standardized database. However, the FSL is very willing to make data available for loading into FSVEG or other modules. However, the FSL does not see much application of any NRIS data for their purposes.

F. Hydrologic Data

The Alaska Region has identified the business requirements for watershed analysis and has identified eight key aquatic resource questions that would commonly be addressed in a Watershed Analysis. Addressing these questions often requires data elements from most or all NRIS modules. The number of shared data elements and the relations between individual data items are numerous and complex.

G. Fauna

The Alaska Region has identified potential components that would fit in the NRIS Fauna module, but the needed analysis associated with wildlife requires information about habitat and ecological conditions developed from data housed in the other NRIS modules. NRIS Fauna development has been deferred.

H. Human Dimensions

The Alaska Region has a Human Dimensions Action Plan that recommends a Regional Human Dimensions Modules Coordinator and Creation of an interdisciplinary Human Dimensions Module working group.

The Region has performed a Needs Assessment for Human Dimensions/Social Science-related resources, including Subsistence Issues, Socio/Economic Issues, and Recreation and Scenery Management issues.

I. Decision Support Systems

The Alaska Region has plans for a Decision Support Systems action team which will evaluate existing Decision Support Systems and identify those which should be supported in NRIS Decision Support System development.

C: List of MAR items related to inventories

PERFORMANCE INDICATOR DEFINITIONS COMPARISON
D R A F T 8/4/99

Proposed FY2000

Changes from FY1999

PHYSICAL DIMENSIONS	
Aquatic ecological unit inventories (miles/acres)	No Changes
Riverine Valley Segment Scale Inventory (MAR 13.2)	
Riverine Stream Reach or Channel Unit Scale Inventory (MAR 13.3)	
Lacustrine Lake Type Scale Inventory (MAR 13.4)	
Lacustrine Lake Zone or Site Scale Inventory (MAR 13.5)	
Terrestrial ecological unit inventories (acres)	No Changes
TEUI at Eco-subregion (Section, Subsection) Scale (MAR 60.7)	
TEUI at Landscape Scale (MAR 60.8)	
TEUI at Land Unit Scale (MAR 60.9)	
Air quality related values inventoried/monitored (AQRVs):	Splits Inventory and Monitoring Activities, Changes Unit of Measure
Air Quality Related Values Inventoried (Acres)	Air Quality Related Values Inventoried and Monitored (AQRV)(MAR 81.2)
Air Quality Related Values Monitored (Acres)	
Resource Monitoring (Sites)	
Soil Resource Monitoring (Sites)	
Water Resource Monitoring (Sites)	

BIOLOGICAL DIMENSIONS	
Vegetation inventory (acres)	
Vegetation Inventory for Landscape Scale (MAR 60.A)	New
Vegetation Inventory for Land Unit Scale (MAR 60.B)	New
	Eliminated Forest Resource Inventory (MAR 60.1) Rangeland Resource Inventory (MAR 60.2)
Terrestrial fauna inventory (acres)	
Terrestrial Fauna Inventory for Landscape Scale (MAR 60.C)	New
Terrestrial Fauna Inventory for Land Unit Scale (MAR 60.D)	New
Aquatic biota inventory (miles)	
Aquatic Biota Inventory for Riverine Valley or Stream Reach Scale (MAR 60.5)	Replaces Stream Aquatic Biota Inventory (MAR 60.5)
Aquatic Biota Inventory for Lake Type or Lake Zone Scale (MAR 60.6)	Replaces Lake Aquatic Biota Inventory (MAR 60.6)
	Eliminated Wildlife Habitat Inventory (MAR 60.3) TE&S Habitat Inventory (MAR 60.4)

HUMAN DIMENSIONS	
Human dimensions inventory (acres)	
Social Profile for County or State Scale (Acres)	New
Social Profile for Community Scale (Acres)	New
Economic Profile for County or State Scale (Acres)	New
Economic Profile for Community Scale (Acres)	New
Recreation Use Monitoring (Sample Days)	New
Heritage Resource Inventories (Acres)	Replaces Heritage Inventory (MAR 61.9)

ASSESSMENTS	
Ecoregion (Domain/Division/Province Scale Assessments (MAR 13.6)	No Change
Eco-subregion (Section)/River Basin & SubBasin Scale Assessments (MAR 13.7)	No Change

Landscape/Watershed Scale
Assessments (MAR 13.8)

Assessment Standard Changed

D: Definitions of terms

bioregional assessment: *there is no clear definition at this time, the term is frequently used interchangeably with ecoregion assessment. The Committee of Scientists purposefully chose to not define the term and accept ecoregion assessment as a synonym. With that caveat bioregional assessment can be somewhat described as: assessment of biological (and physical) conditions of life and other living species in the area in which they live presumably in order to exercise greater care in the use they make of the bioregion. Based on Bioregional Assessments, Science at the Crossroads of Management and Policy" K.N. Johnson, et al. 1999*

Customer: Anyone who is affected by the product or by the process used to produce the product. Customers may be external or internal. (Juran, 1998)

Deficiency: Any fault (defect or error) that impairs a product's fitness for use. (Juran, 1998)

ecology 1. the study of the relations of organisms to one another and to their surroundings. 2. The study of the interaction of people with their environment. (*Oxford dictionary of current English*)

ecoregional assessment: assessment of biological organisms and their surroundings including the interactions of people with their environment in terms of ecological, social, and economic systems. (*no particular source, just a mix of 'bioregional assessment' and 'ecology' with a people twist*)

integrate. combine (parts) into a whole (*Oxford dictionary of current English*)

forest inventory 1. a set of **objective** sampling methods designed to quantify the spatial distribution, composition, and rates of change of forest parameters within specified levels of precision for the purposes of management. 2. the listing (enumeration) of data from such a survey - *synonym* cruise, forest survey -- note inventories may be made of all forest resources and including trees and other vegetation, fish, insects, and wildlife, as well as street trees and urban forests trees
From "The Dictionary of Forestry", Society of American Foresters, 1999

resource inventory Collection of data for analysis of the status or condition of resources *From Resource Conservation Glossary, 2nd edition, 1982. Soil Conservation Society of America, Ankeny, Iowa*

inventorying: gathering data needed for analyses and evaluation of the status or condition of a specific universe or area of concern *From Resource Conservation Glossary, 2nd edition, 1982. Soil Conservation Society of America, Ankeny, Iowa*

Integrated Resource Inventories/Resource Monitoring: inventories designed to meet multiple needs for information and consist of "...data collection for analysis of the status or conditions of resources or other vegetative or physical characteristics required for planning..." (FSH 1909.4). Several types of integrated inventories are utilized for forest planning: **Physical Dimensions** (Terrestrial and Aquatic Ecological Units, both linked to National Hierarchical Frameworks and Air Quality Related Values), **Biologic Dimensions** (Existing Vegetation, Terrestrial Fauna, and Aquatic Biota), and **Human Dimensions** (Recreation Use, Heritage, Social, and Economic data). Integrated

resource inventories provide a scientific basis and ecological context for landscape and watershed analysis for Forest planning activities. *From FY 2000 Planning and Budget Advice, USDA Forest Service draft 8/31/99*

monitoring the collection of information over time, generally on a sample basis by measuring change in and indicator or **variable**, to determine the effects of resource management treatments in the long term

From "The Dictionary of Forestry", Society of American Foresters, 1999

monitoring program vs. repeated inventories: Many people suppose monitoring occurs when an inventory is repeated. This is not necessarily the case. Monitoring should include goals toward which comparisons are made, thresholds for changes detected, and proposed actions that would be undertaken in the event thresholds are met for any item of interest being monitored. (Patrice Janiga)

system. complex whole; set of connected things or parts; organized body of things (*Oxford dictionary of current English*)

systems analysis analysis of a complex process etc. in order to improve its efficiency (*Oxford dictionary of current English*)

systems approach to inventory a methodical process of inventory design that encompasses the parts of systems (ecological, social, and economic) and the processes associated with the relations among these parts that results in the ability to be responsive through time and across scales and to be a sound foundation upon which special surveys can be built to respond to the myriad of issues that arise over time.

integrated inventory a compilation of resource-specific inventories that can be integrated through analysis techniques and tools such as applications of GIS. Also, coordinated collection and storage of inventory measurements and observations into a unified and well-defined data management system.

scientific credibility within an inventory program. the combination of (1) tested and accepted protocols, (2) quality assurance practices, and (3) quantification of uncertainty throughout the design and implementation of an inventory (including analysis phases and portrayal of uncertainty associated with products (information, maps, reports) from an inventory program

In the world of managing for quality, there is still a notable lack of standardization of the meanings of key words. Any organization can do much to minimize internal confusion by establishing its own glossary. Also, definitions of words do not remain static as philosophies and understanding of quality evolve. "Quality" means those *features of products* which meet customer needs and thereby provide customer satisfaction. The purpose of higher quality is to provide greater customer satisfaction, however providing more and/or better quality usually requires an investment and hence usually involves increases in costs. "quality" means *freedom from deficiencies* - freedom from errors that require doing work over again or that result in field failures, customer dissatisfaction, customer claims, and so on. (Juran, 1998)

Quality Management System: management procedures that are used to achieve, monitor, control, and improve the functional, financial, and human relations performance of an enterprise or program. Management procedures should incorporate quantitative metrics and other criteria ("report cards") to monitor and evaluate the performance of the organizational units and personnel. Metrics which have exclusive focus on costs, yields, and output, provide disincentives; thus 'report card' design is a key element of quality management. (Juran, 1998)

ISO 9000 standards: a family of international standards for quality management and quality assurance. The ISO 9000 standards deal with the management systems used by organizations to design, produce, deliver, and support their products or services. They are applied in a wide range of industry/economic sectors and government areas. The standards apply to all generic product categories: hardware, software, processed materials, and services. The standards provide guidelines or requirements on *what* features are to be present in the management system of an organization but do not prescribe *how* the features are to be implemented. (Juran, 1998)

Product: The output of any process. (Juran, 1998)

Customer: Anyone who is affected by the product or by the process used to produce the product. Customers may be external or internal. (Juran, 1998)

EPA: Environmental Protection Agency

USGS: United States Geological Survey

TES: Threatened and Endangered Species

MIS: Management Indicator Species

NRCS: Natural Resource Conservation Service

FWS: Fish and Wildlife Service

ECOMAP: Ecoregional map classification

MLRA: Major Land Resource Area

Juran, Joseph M. and A. Blanton Godfrey. Juran's Quality Handbook, fifth edition, McGraw Hill