Organizational Assessment for U.S. Forest Service Research & Development

NATIONAL ACADEMY OF
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Organizational Assessment for U.S. Forest Service Research and Development

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Foreword

The United States Forest Service has a long and proud history, applying science to the sustainable management of the nation's forests and rangeland through a decentralized organizational structure that enables it to be responsive to the varied environments presented by different regions of the country. While decentralization is a strength of the Forest Service, it also presents significant challenges for enterprise-level communication and coordination with internal and external stakeholders.   The decentralized organizational structure and processes also make it difficult for Forest Service leaders to consistently link their policy and management decisions to a scientific research agenda across regions and at the agency level. Budget pressures imposed by the extraordinary costs of wildfires in recent years have brought greater attention to these challenges, and prompted calls for innovative approaches that better link the agency's research agenda with its mission, budget, and partners.

In this context, the Forest Service contracted with the National Academy of Public Administration (the Academy) to undertake an eight-month, independent assessment of the Forest Service research enterprise. In its assessment, the Academy was called upon to identify opportunities for improvement in two areas:

1. Alignment of Forest Service Research and Development (R&D) with the needs of its internal Agency partners;
2. Communication with external stakeholders, especially Congress, about its research activities, their alignment with mission needs, and their impact

The Academy assembled a six-member Panel of expert Academy Fellows to guide and oversee the assessment conducted by a professional study team. This report presents the Panel's findings and recommendations, which include actions to institutionalize more systematic collaboration between R&D and its internal Agency partners, and to enable the identification of Region-level mission needs and priorities to guide R&D efforts at the regional and enterprise levels. Panel recommendations also address how the Forest Service can develop a continuous process of learning and alignment at the enterprise level to inform not just improved communications with internal and external stakeholders but continuous adjustment in a dynamic environment.

I appreciate the support of Forest Service leaders and other stakeholders who provided important insights and context that inform this report. I extend my sincere thanks to the Academy Fellows who served on the Panel and provided invaluable expertise and thoughtful guidance to the professional study team that undertook this project. We anticipate that Forest Service leaders will find herein recommendations that support their goals for the organization and perpetuate its extraordinary reputation.

Teresa W. Gerton
President and Chief Executive Officer
National Academy of Public Administration

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Acronyms and Abbreviations

Acronym or Abbreviation	Definition
ARS	Agricultural Research Service
FPL	Forest Products Lab
FY	Fiscal Year
GAO	United States Government Accountability Office
GPRAMA	Government Performance Reporting and Modernization Act
HQ	Headquarters
IDA	Institute for Defense Analyses
IITF	International Insitute of Tropical Forestry
IMAR	Inventory, Monitoring, & Assessment Research
KMC	Knowledge Mangement & Communications
LRESR	Landscape Restoration and Ecosystems Services Research
NEPA	National Environmental Policy Act
NFS	National Forest System
NIFA	National Institute of Food and Agriculture
NOAA	National Oceanic and Atmospheric Administration
NRS	Northern Research Station
OPM	Office of Personnel Management
PNW	Pacific Northwest Research Station
PRA	Priority Research Area
PSW	Pacific Southwest Research Station
R&D	Research & Development
REA	Rsearch Emphasis Areas
RGEG	Research Grade Evaluation Guide
RMRS	Rocky Mountain Research Station
RSAT	Regional Science Advisory Team
S&PF	State & Private Forestry
SFMR	Sustainable Forest Management and Research
SPA	Strategic Program Areas
SRS	Southern Research Station
T&D	Technology & Development
The Academy	National Academy of Public Administration
The Forest Service	United States Forest Service
USDA	United States Department of Agriculture
WO	Washington Office

Executive Summary

The Forest Service contracted with the National Academy of Public Administration (the Academy) to undertake an eight-month, independent assessment of the Forest Service research enterprise. In its assessment, the Academy was called upon to identify opportunities for improvement in two areas.

1. The alignment of Forest Service Research and Development (Forest Service R&D) with the needs of its internal Agency partners.

2. Communication with external stakeholders, especially Congress, about its research activities, their alignment with mission needs, and their impact.

The Academy formed a six-member Panel of expert Academy Fellows to oversee and provide guidance to a professional Academy study team in performing the assessment. The Panel's conclusions and recommendations are summarized below.

Improving Integration between Forest Service R&D and Customers
The effective integration of science with management and policy decision making even at science-based agencies is a continuing challenge across the federal government. This challenge stems in part from differences in the culture and incentives of research and operational personnel.

Best practice is for research and operational personnel to be engaged throughout the R&D process, beginning with research and design through the development and communication of research products. Agency users can not only identify needs, but offer insights that inform research questions and clarify study scope and methodology, while scientists bring expertise to ensure that research design is feasible and follows scientific principles.

Historically, Forest Service R&D has not systematically engaged its mission partners in the research and development process. In recent years, individual research stations have been experimenting with more collaborative approaches to engaging both internal agency partners and external customers. While promising, these efforts face significant challenges. For instance, the education of scientists generally does not include the skills needed to effectively engage non-specialist users and decision makers. Also, the performance evaluation systems for scientists as they are presently applied do not

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consistently encourage collaboration with operational personnel or a focus on mission-oriented outcomes.

To help institutionalize more collaborative approaches to research, the Panel makes several recommendations. These provide for targeted skills training, career development opportunities, changes in how Forest Service R&D approaches performance evaluation, and more robust customer feedback mechanisms.

Closely related to efforts to support more collaborative approaches to research, are efforts to institute processes to bring researchers and operational personnel together to identify mission-related research needs and priorities at the Region level. Notable examples discussed in the report include the ongoing efforts by the Southern and Rocky Mountain Research Stations.

These individual Station efforts to engage in more collaborative, Region-level research planning efforts are promising. However, the question is how to systematically learn from these efforts and translate this experience to other Stations and Regions. To enable more systematic learning and successful transfer of effective practice to other Regions, the Panel makes several recommendations. These include treating individual station efforts as pilot projects, and holding an annual conference of Research Station and Region personnel to encourage collaboration and learning across stations and regions.

Improving Enterprise-level Communications
The Panel's overarching conclusion is that Forest Service R&D should take steps to institutionalize processes supporting continuous learning and alignment at the enterprise level to inform not just improved communications with internal and external stakeholders but timely adjustment in a dynamic environment.

The Panel recommends a staged approach including near-term and longer-term efforts. In the near-term, this entails gathering available documentation (e.g., mission statement, budgets, performance reporting) and engaging key internal and external stakeholder groups (e.g., station directors, mission partners and customer groups) to obtain information and to understand the different perspectives needed for an integrated picture of the organization.

Longer-term efforts entail creating or strengthening formal recurring processes of collecting and reporting information, assessing performance, and engaging with stakeholders. The Panel gives particular attention to the following processes:

- Requirements and priority setting processes

- Collection and reporting of information on funding allocation and research activities across the enterprise
- Collection and reporting of accomplishments and other performance information
- Congressional engagement process

The Panel emphasizes that a key consideration in developing standard processes for collection, reporting, and engagement is making sure to leverage existing processes, guidance, and requirements, including those related to the Government Performance Reporting and Modernization Act (GPRAMA) and the Evidence-based Policy Act, under which agencies are required to develop learning agendas – plans for developing evidence supporting agency planning and decision making.

It is logical and efficient to integrate the strategic planning and priority setting processes for R&D with the statutory requirements and agency procedures for updating the Department's (and Forest Service's) GPRAMA-required strategic plan every four years, for conducting annual strategic reviews of performance to inform budget and management decisions, and for developing and reporting performance metrics as required.

Also, as the research component of the Forest Service, R&D is well-situated to take responsibility for developing a learning agenda for the Forest Service to meet the new statutory requirement and address OMB guidance. Doing so will help ensure that the research priorities and communications activities of R&D are addressing the main gaps in knowledge that must be filled in order to improve the Forest Service's ability to accomplish its mission.

By aligning with mandated, recurring planning and agenda setting processes, R&D can ensure and demonstrate a tighter connection between its priorities and those of its partners and stakeholders, thereby making it easier to communicate its contributions.

More specifically, the Panel identifies opportunities to improve enterprise-level communications in four areas:

1. R&D investment priorities and resources allocation
2. How the research stations fit within an R&D enterprise strategy
3. The value of research and how it fits into the broader array of R&D activities
4. R&D contributions to the Forest Service's mission

In each of these areas, the Panel suggests actions that might be taken both in the near- and longer-term as part of its recommendation to institutionalize a continuous learning process.

A complete list of the Panel's nine recommendations is provided below, organized by the section of the report where the recommendations are presented.

List of Panel Recommendations

Section 3: Integrating R&D and Agency Partners

Recommendation 3.1: Provide training and career development opportunities to enable staff to build the skills to engage agency partners. As discussed in the Leading Practices section, effective science-agency interface requires a different set of skills (e.g., the ability to communicate scientific information to non-scientists, the ability to work effectively with agency staff in a political environment, and the ability facilitate cooperation and communication) from traditional scientific research. R&D should conduct a training needs assessment to identify the important skills required to facilitate scientists-agency interactions and determine skills gaps in the organization

Recommendation 3.2: Design career tracks and provide career advancement opportunities to reward employees who desire to take on "boundary spanning" responsibilities and encourage research-agency integration.

Recommendation 3.3: Develop performance metrics that emphasize the contribution of research to agency's mission to supplement the Research Grade Evaluation Guide. Scientists should be held accountable for engaging agency partners and strengthening the connection between research and agency mission needs.

Recommendation 3.4: Review its panel evaluation process and identify opportunities for improvement. One potential option is to require that each review panel include at least one rating member selected from non-R&D technical staff (e.g., National Forest System technical staff) to emphasize the contribution of research to agency mission needs and enhance research-agency integration.

Recommendation 3.5: Conduct an annual survey to measure agency partner satisfaction with R&D's products and support and identify opportunities for improvement.

Recommendation 3.6: Treat RMRS' RSAT effort as a pilot project for a new approach to regional collaboration. RSATs provide a promising model for translating ad-hoc research-NFS collaborations into a more systematic, institutionalized relationship. RSATs are still in early stages, and R&D should establish a formal process to evaluate the benefits, costs, and

risks associated with this effort and test applicability enterprise-wide. Pilot testing will assist R&D leadership in identifying the general elements of an effective enterprise-wide policy guidance.

Recommendation 3.7: Hold an annual conference to bring together representatives from research stations, NFS, and other agency stakeholders to provide networking opportunities, encourage cross-research station collaboration, and serve as a community of practice for the integration of science and agency policy decisions. The Deputy Chief R&D should host this annual conference and set the agenda.

Recommendation 3.8: Issue policy guidance to institute a more systematic, institution-wide approach to engaging agency partners throughout the lifecycle of most, if not all, research projects. The Panel recognized that the Deputy Chief R&D does not have direct line authority over research stations and mostly relies on an "influence and persuasion" type of leadership approach. The purpose of the policy guidance is to provide some general principles that research stations should follow when they establish their own processes to integrate scientific research with agency policy decisions. However, this does not mean that all research stations should establish their collaboration process in the exact same way. Given their diverse research needs, flexibility is essential for research stations to carry out its functions effectively. Each research station should adapt the guidance based on their specific needs and environment.

Section 4: Improving Enterprise-level Communications

Recommendation 4-1: **Develop and implement a continuous process of learning and alignment**.

- o *Recommendation 4-1a*: Begin with an assessment of the current state and near term actions to improve communication with stakeholder about the rationale, operations and accomplishments of the enterprise.
- o *Recommendation 4-1b*: Based on gaps identified during the initial assessment develop standard processes, including evaluation processes to help ensure more robust information and enable continuous improvement.

Section 1: Introduction

The United States Forest Service (the Forest Service), established in 1905 and housed within the U.S. Department of Agriculture (USDA), is charged with "sustaining the health, diversity, and productivity of the nation's forests and grasslands to meet the needs of present and future generations."[1] Acknowledging the importance of an independent research branch, the agency's second Chief, Henry Graves established the Forest Service Research and Development (R&D) Deputy Area in 1915.[2] Today, Forest Service R&D Washington Office (WO) provides national oversight and overall strategic direction for Forest Service R&D programs. The WO R&D oversees research programs across five regional research stations, one national laboratory, and one international institute.[3]

Project Origin and Scope

In 2015, the Forest Service Executive Leadership Team asked R&D whether current research activities aligned with the management needs of its key internal customers, the National Forest System (NFS) and State and Private Forestry (S&PF) Deputy Areas. The main recommendation of the resulting internal review was to improve coordination and collaboration between the regional research stations and WO R&D in meeting the Forest Service's land management needs. Recently, the Senate Appropriations Committee directed Forest Service R&D to minimize redundancy and maximize cost effectiveness while better communicating the importance of its research to both internal and external customers.[4]

Building on previous findings and congressional concern, the Forest Service contracted with the National Academy of Public Administration (the Academy) to undertake an eight-month, independent assessment of the Forest Service research enterprise.[5] The Academy assembled a six-member Panel of Academy Fellows to oversee the work of a professional Academy study team (see Appendix A for Panel and project staff

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[1] United States Forest Service. n.d. *About the Agency.* Accessed August 13, 2019. https://www.fs.fed.us/about-agency.
[2] David Wear and James Vose, "Considering the Future of Forest Service Research and Development"
[3] The national laboratory and the international institute are treated as research stations for both programmatic and fiscal purposes and are herein included in the references to research stations.
[4] 115th Congress, 2d Session. 2018. "Department of the Interior, Environment, and Related Agencies Appropriations Bill, 2019." Washington, DC: United States Senate. Report 115-276.
[5] The term "research enterprise" is used throughout this report to refer to the research and development activities of the Forest Service broadly and to avoid confusion with the Deputy Area and Washington Office, commonly referred to as R&D.

biographies).

The Academy's assessment had three main scope elements.

1. Identifying opportunities for improving Forest Service R&D's alignment with internal Agency customer needs.

2. Identifying opportunities to improve communication with external stakeholders, especially Congress, about its research activities, their alignment with mission needs, and their impact.

3. Develop actionable recommendations that can inform the Forest Service efforts to strengthen its research enterprise.

In its assessment of the Forest Service R&D enterprise, the Panel has focused on the Forest and Rangeland Research programs, which have faired relatively poorly in budget terms compared to the Forest Inventory and Assessment (FIA) program. Despite overall cuts to the Forest Service budget, FIA's funding continues to increase through strong partner and user group support. From fiscal year (FY) 2008 to FY 2018, FIA experienced an appropriations increase of 2.38 percent in real dollars compared to the overall Forest Service R&D appropriations which decreased by 10.72 percent.[6]

Study Approach and Methodology

The study team completed an extensive review of policy documents provided by Forest Service R&D, as well as related documents from potential benchmark/comparable agencies and other stakeholders/experts. These include:

- Forest Service Research and Development National Science Plan;

- Forest Service R&D Performance and Accountability Report FY 2015 & FY 2016;

- Rocky Mountain Research Station Communication Strategy;

- USDA Toward Shared Stewardship Across Landscapes: An Outcome-Based Investment Strategy;

- USDA Forest Service Budget Justifications;

- 2018 NOAA Science Report; and

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[6] Based on 2018 dollars.

- Boundary Spanning at the Science—Policy Interface: The Practitioners' Perspectives.

The study team conducted 44 interviews with Forest Service employees, internal stakeholders, and external stakeholders, including: [7]

- Forest Service senior officials and staff;

- Forest Service WO R&D staff;

- Forest Service R&D Research Station staff;

- National Forest System staff;

- WO leadership and senior officials within the Forest Service R&D Deputy Area;

- WO leadership/senior program officials with other Deputy Areas: National Forest System, State and Private Forestry and Business Operations;

- Leadership of the Forest Service Research Stations and the National Forest Products Lab;

- Communications staffs at selected Research Stations;

- Congressional Appropriations Committee staff;

- Office of Management and Budget;

- Selection of State Foresters, including members of the National Association of State Foresters, Western Council of State Foresters, and California Forestry Association;

- Representatives of external forestry-related groups including: National Association of University Forest Resource Programs, Society of American Foresters, American Forest Foundation, U.S. Endowment for Forestry and Communities, and the Nature Conservancy; and

- Representatives of other major federal agency funders of forestry-related research, including the National Institute of Food and Agriculture (NIFA) and the Agricultural Research Service (ARS).

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[7] See Appendix B for a complete interview list

Organization of the Report

The Panel organized this report into four sections.

Section 1 reviews the project scope and methodology.

Section 2 provides background information on the Forest Service and Forest Service R&D as context to the report's analysis and recommendations.

Section 3 discusses the efforts of Forest Service R&D to achieve greater integration with its customers and, in particular, its internal customers. This section focuses on research station efforts to adopt more collaborative approaches to working with customers and to build the capacity to coordinate with customers at the regional level to identify mission needs and develop priorities.

Section 4 provides guidance on how to improve the ability of R&D to communicate at an enterprise level with internal and external stakeholders. It focuses on four communications challenges, but provides guidance within a broader framework of developing an ongoing, enterprise-level cycle of organizational learning and alignment.

Section 2: Background

This section provides a brief history of the Forest Service Research and Development (R&D) Deputy Area as it is relevant to understanding the environment in which the research enterprise currently operates. The mission of Forest Service R&D, its budget, and organizational structure will also be reviewed to provide context for a discussion of its overall communication challenges.

History

Federal investment in forest-related research began within the USDA during the 1870s, prior to the creation of the Forest Service.[8] During the early years following the Forest Service's creation, research studies that had implications for management and policy fed controversial debates that engendered conflict between researchers and land managers.[9] Acknowledging the importance of an independent research branch, the Agency's second Chief, Henry Graves established the Forest Service Research and Development arm in 1915.

Over the next fifty years, Forest Service R&D expanded the scope of its work to address the needs of user groups in industry, conservation, and private ownership. Following environmental legislation in the 1970s, Forest Service R&D's scope broadened to include the impacts of environmental change on management practices, and larger scale resource assessments. As new research showed that environmental impacts on forests were not limited to forest boundaries, the Forest Service research enterprise expanded beyond a production-centric focus to an "all-lands" approach to forest management as it began to investigate landscape and regional level issues.[10]

Its long history of scientific independence has shaped the structure and function of Forest Service R&D Deputy Area today. While Forest Service R&D, as a separate branch, allowed for "credibility through objectivity," one review of the Forest Service's research operations observed that, "by its very nature, an independent research operation sets

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[8] Charles Valentine Riley Memorial Foundation. 2018. "Forest Service Research and Development: Creating the Knowledge Needed to Manage America's Forest Sustainably." Madison. https://rileymemorial.org/files/files/RMF%20FS%20Special%20Report%20Final%205-31-18.pdf.

[9] Wear, David N, and James M Vose. n.d. "Considering the Future of Forest Service Research and Development." *Center for Integrated Forest Science and Synthesis* (United States Department of Agriculture: Forest Service - Southern Research Station; North Carolina Statue University - Department of Forestry and Environmental Resources).

[10] Ibid

the stage for some tension and conflict with other branches of the Forest Service."[11]

The Forest Service is a largely decentralized organization. At its point of origin, the Agency was based on European forestry management models.[12] One attribute of such models is "a decentralized decision-making structure with considerable discretion given to field managers."[13] This model was appropriate to the Forest Service due to the necessity of addressing differing needs across geographies, regions, and localities as well as to deal with the reality of poor communications infrastructure at the time. These two factors played an important role in the decision to organize the agency in a decentralized manner.

The reorganization of Forest Service research programs in the early 2000s saw the consolidation of Forest Service R&D's eight research stations into five.[14,15,16,17] Forest Service R&D consisted of 1,831 full-time employees in FY 2016 including approximately 500 scientists spread across 67 field sites across the United States.[18] Today, the largely decentralized organizational structure of the Forest Service continues to present challenges in coordination and communication in R&D, and the Agency more broadly.

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[11] Wear, David N, and James M Vose. n.d. "Considering the Future of Forest Service Research and Development." *Center for Integrated Forest Science and Synthesis* (United States Department of Agriculture: Forest Service - Southern Research Station; North Carolina Statue University - Department of Forestry and Environmental Resources).
[12] MacCleery, Doug. 2008. "Re-Inventing the United States Forest Service: Evolution from Custodial Management, to Production Forestry, to Ecosystem Management." In *Re-Inventing Forestry Agencies: Experiences of Institutional Restructuring in Asia and the Pacific*, by Asia-Pacific Forestry Commission. Bangkok: Food and Agriculture Organization of the United Nations - Regional Office for Asia and the Pacific. http://www.fao.org/3/ai412e/AI412E06.htm.
[13] Ibid.
[14] Wear, David N, and James M Vose. n.d. "Considering the Future of Forest Service Research and Development." *Center for Integrated Forest Science and Synthesis* (United States Department of Agriculture: Forest Service - Southern Research Station; North Carolina Statue University - Department of Forestry and Environmental Resources).
[15] Hansen, The Honorable James V. 2000. "Forest Service: Consolidation of the Rocky Mountain Forest and Range Experiment Station with the Intermountain Research Station." Washington, DC: United States General Accounting Office, November 16. https://www.gao.gov/assets/100/90610.pdf.
[16] United States National Archives and Records Administration. 2016. *Records of the Forest Service.* Washington, DC, August 15. https://www.archives.gov/research/guide-fed-records/groups/095.html.
[17] U.S. Endowment for Forestry and Communities. 2014. "A New Model for Forest Sector Research and Development in the United States." https://www.usendowment.org/wp-content/uploads/2018/10/forest_r_d_final_1.29.14-1.pdf.
[18] United States Forest Service. December 2017. "Forest Service Research and Development Performance and Accountability Report - Fiscal Year 2016." United States Department of Agriculture, Washington, DC. https://www.fs.fed.us/sites/default/files/fs_media/fs_document/15937_fs_par_2016_508.pdf.

Mission and Functions

Forest Service R&D's mission is to "conduct innovative and seminal research that provides sound science, innovative technologies, and practical applications to improve the health and productivity of our Nation's forests and grasslands, inform natural resources policy and land management decisions, and anticipate emerging natural resource issues."[19]

The Forest and Rangeland Renewable Resources Research Act of 1978 is the current legislative authority for the Forest Service R&D program.[20] The Act underlines the importance of research to provide sound science to address challenges on public and private lands and to inform natural resources policy and management decisions. It is written in a mission-focused way, providing direction to solve practical problems.[21]

Research is clearly a cornerstone of R&D. However, in keeping with the direction to solve practical problems, R&D undertakes an array of activities including application development, decision support, and applied research and development supporting the commercialization of products and processes. The latter reflects in part R&D's long-standing role in supporting the development of markets in forest products.

Inventory and monitoring is another important R&D activity, encompassing long-term data collection by the Forest Inventory and Analysis program at the national scale and more localized data collection carried out in Forest Service R&D's many experimental forests. These long-term data collection efforts support research and a range of analyses.

Scientific integrity is a key cultural component of the Forest Service research enterprise, "independence and objectivity are key ingredients of scientific credibility, especially in research organizations that are part of a natural resource management agency like the Forest Service."[22] Forest Service R&D acknowledges the need to be responsive to management needs and inform policy, while maintaining this credibility and

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[19] United States Forest Service. December 2017. "Forest Service Research and Development Performance and Accountability Report - Fiscal Year 2016." United States Department of Agriculture, Washington, DC. https://www.fs.fed.us/sites/default/files/fs_media/fs_document/15937_fs_par_2016_508.pdf.

[20] Public Law 95-307; as amended. 16 U.S.C. 1641-1650

[21] An analysis of this legislative authority is provided in Charles Valentine Riley Memorial Foundation. (2018). *Forest Service Research and Development: Creating the Knowledge Needed to Manage America's Forest Sustainably.*

[22] Ruggiero, Leonard F. 2007. *Scientific Independence: A Key to Credibility.* Bitterroot Ecosystem Management Research Project, Missoula: USDA Forest Service: Rockey Mountain Research Station, Bitteroot national Forest, Region 1, the University of Montana College of Forestry and Conservation. https://www.fs.fed.us/rm/pubs_other/rmrs_2007_ruggiero_l001.pdf.

independence. This is indicated in Rocky Mountain Research Station's statement of its values, "new knowledge is provided through a balance of basic and applied research and short- and long-term studies at a variety of scales."[23] However, the authors of a collaborative publication by Rocky Mountain Research Station and the University of Montana also recognize that confusion over the respective roles of researchers and managers has somewhat hampered the relationship between the National Forest System (NFS) and Forest Service R&D.[24] Scientist credibility is also important within the agency not just to preserve Forest Service R&D's ability to set study goals and choose methodological techniques without pressure to conform to a desired outcome, but to assure transparency and the trust of the public.[25]

Prior to its FY2020 budget justification, Forest Service R&D had organized its scope of research into seven Strategic Program Areas (SPAs).[26] The purpose of the SPAs was two-fold: to take an integrated approach to the study of the large breadth of issues in the larger scope, and to provide transparency for the public, user groups, internal agency partners, Congress, and budget formulation. Forest Service R&D also used five Priority Research Areas (PRAs) to represent the broad level current and emerging research issues impacting National Forests.

For FY 2020, the Deputy Chief of Forest Service R&D has identified four national research priorities, three areas of foundational research, seven discipline areas, and three types of R&D deliverables aimed at meeting national mission priorities – primarily focused on the management of NFS lands.[27]

The four national research priorities are:

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[23] United States Forest Service: Rocky Mountain Research Station. n.d. *Our mission, vision, and values.* Accessed August 13, 2019. https://www.fs.fed.us/rmrs/our-mission-vision-and-values.

[24] Ruggiero, Leonard F. 2007. *Scientific Independence: A Key to Credibility.* Bitterroot Ecosystem Management Research Project, Missoula: USDA Forest Service: Rockey Mountain Research Station, Bitteroot national Forest, Region 1, the University of Montana College of Forestry and Conservation. https://www.fs.fed.us/rm/pubs_other/rmrs_2007_ruggiero_l001.pdf.

[25] United States Forest Service: Rocky Mountain Research Station. n.d. *Our mission, vision, and values.* Accessed August 13, 2019. https://www.fs.fed.us/rmrs/our-mission-vision-and-values.

[26] United States Forest Service. December 2017. "Forest Service Research and Development Performance and Accountability Report - Fiscal Year 2016." United States Department of Agriculture, Washington, DC. https://www.fs.fed.us/sites/default/files/fs_media/fs_document/15937_fs_par_2016_508.pdf.

[27] Information on the national research priorities, areas of founational research, and categories of strategic deliverables was provided by Forest Service R&D officials to the Academy study team on September 25th, 2019.

1. Applied science to support shared stewardship and improve forest conditions (e.g. market analyses, scenario planning, large landscape research, and decision support)
2. Forest inventory and trend analysis (e.g. FIA)
3. Ehancements to the wildland fire system (e.g. predictions, planning, impact assessment, and recovery)
4. Wood product and market innovations

Three areas of research are identified as foundational to the accomplishment of the agency's mission. These foundational research areas are:

1. Forest and Grassland Health
2. Forest Soils, Air Quality, and Hydrology
3. Silviculture and Ecology

Seven discipline areas within Forest Service R&D are identified as collectively and mutually contributing to the four national research priorities and the three areas of foundational research. These discipline areas are:

1. Water, Soil, and Air
2. Fire and Fuels Science
3. Urban, Recreation, and Human Dynamics,
4. Forest and Grassland Health
5. Wildlife, Fish, and Forest Ecology
6. Natural Resource Management and Economics
7. Forest Products, Engineering, and Operations

The three types of R&D deliverables:

1. Innovations and Discovery
2. Inventory and Assessment
3. Decision Support

Technical staff beyond Forest Service R&D Deputy Area

The other two Deputy areas also employ a large number of scientifically trained staff, but they are not involved in research and are focused on management issues. It is not clear from Agency documentation how many scientifically trained staff members are employed by the other two Deputy Areas. At the Regional Office level, these staff are regarded as specialists in their disciplines, and manage programs and provide

consultative support for land management implementation efforts within those respective disciplines. This type of technical staff is also involved in drafting documents to fulfill reporting requirements on environmental impacts as set forth in the National Environmental Policy Act (NEPA).

Also outside the R&D function, the Forest Service operates two Technology and Development (T&D) centers in the National Technology and Development Program, housed in NFS at WO under Engineering, Technology & Geospatial Services.[28],[29] The T&D centers are charged with the mission of "the systematic application of scientific knowledge to create new or substantially improved equipment, systems, materials, processes, techniques, and procedures to meet the objectives of advanced forest management and utilization."[30] These two operations are the Missoula Technology and Development Center in Montana established in the late 1940s, and the San Dimas Technology and Development Center in California established in 1945. The former initially focused on the development of equipment for the Forest Service's air operations, while the latter developed equipment for fire operations. Currently, T&D projects focus on fire and aviation management, engineering, health and safety, explosives, global positioning systems, posters and signs, and Forest Service uniforms.

Organizational Structure

At the agency level, the Forest Service is organized into three Deputy Areas:[31]

- **National Forest System** – manages 155 national forests and 20 grasslands lands across 44 States, Puerto Rico, and the Virgin Islands[32]

- **State and Private Forestry (S&PF)** – cooperates with State and local governments, forest industries, and other private landowners and forest users in the

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[28] United States Forest Service. n.d. *Engineering, Technology & Geospatial Services (ETG) Contact Us.* Accessed August 13, 2019. https://www.fs.fed.us/about-agency/contact-us/engineering-technology-geospatial-services.

[29] Leadership connect. n.d. *Forest Service [FS] - Org Charts.* Accessed August 13, 2019. https://app.leadershipconnect.io/org-charts/152140

[30] United States Forest Service. n.d. *Technology & Development.* Accessed August 13, 2019. https://www.fs.fed.us/eng/techdev/index.htm.

[31] United States Forest Service. n.d. *Agency Organization.* Accessed August 13, 2019. https://www.fs.fed.us/about-agency/organization.

[32] United States Forest Service: Technology & Development. n.d. *Welcome to the Forest Service: A Guide for Volunteers.* Accessed August 13, 2019. https://www.fs.fed.us/t-d/pubs/htmlpubs/htm09672813/page02.htm#fig02.

management, protection, and development of forest land in non-Federal ownership

- **Research and Development** – provides the scientific and technical knowledge necessary to protect and sustain the nation's natural resources on all lands

Washington Office Research and Development

Forest Service R&D at WO (WO R&D) provides national oversight and overall strategic direction for its five regionally focused research stations, the nationally focused Forest Products Laboratory (FPL), and one international institute.[33] Drawing from its own internal assessment in 2012, WO R&D reorganized its current organizational structure in 2014 in an effort to maximize performance and efficiency, as well as responsiveness to Agency needs.[34] This office is organized into four staffs: [35]

- **Inventory, Monitoring, & Assessment Research (IMAR)** – responsible for national to landscape-level research and analysis on forest conditions. Leads the FIA program, the Nation's forest census; promotes new techniques for remote sensing, monitoring and geospatial analsysis; assesses past trends and projects future conditions of major renewable resources under climate change; and supports forest commerce through knowledge indicators on U.S. forest sustainability.

- **Knowledge Management and Communications (KMC)** – tasked with increasing awareness of current and potential future research areas, developing messages for clients inside and outside the agency, and improving the awareness, appreciation, and use of scientific knowledge in informing natural resource management and policy decisions.

- **Landscape Restoration and Ecosystem Services Research (LR&ESR)** – provides natural resource managers and policymakers with new science that promotes healthy, resilient, watershed conditions, and wildlife and fish habitats; explores how settings with trees all along the urban-to-wildland gradient create values for

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[33] The national laboratory and the international institute are treated as research stations for both programmatic and fiscal purposes and are herein included in the references to research stations.

[34] Washington Office Research & Development Staff Realignment Team. 2012. *Realignment Recommendations.* Internal Document, Washington, DC: United States Department of Agriculture: Forest Service.

[35] Descriptions of the WO R&D staffs were provided by Forest Service R&D officials on September 25th, 2019. The Policy and Analysis staff, responsible for providing the Forest Service Chief with analyses of agency policies, programs, and practices, was disbanded on November 20th, 2017.

people; creates deeper understanding of how changing economic and societal values impact forests and the goods and ecological services they provide; and, invents wood-based materials that create new markets or expand exisiting markets.

- **Sustainable Forest Management and Research (SFMR)** – provides the foundational science to advance the understanding of interactions between disturbances and forest health and creates restoration strategies to improve productivity and build resilience for public and private forests, rangelands and agro-forested landscapes.

Of these four WO R&D program staffs, three are responsible for providing strategic guidance for R&D programs administered by the research stations.[36] KMC serves as support for agency level leadership and communications activities. It provides two basic services: WO support and station support. In support of the first service, KMC manages internal communications, publication support, the National R&D website, research knowledge and databases, and the National Science Application Team. At the station support level, KMC manages cross-station data and archival processes, patents, and electronic research platform support.

While the Deputy Chief of R&D does not have line authority over the research station directors (these directors report to the Chief of the Forest Service), WO R&D seeks to align the research issue areas pursued at the research stations with agency priorities by approving research station charters detailing research plans and objectives.[37] The WO R&D leadership also uses the funding allocation process as a tool to ensure its priority areas are addressed in the field, though the approval of funding ultimately rests with the Chief of the Forest Service. Forest Service R&D's funding is received primarily through a single appropriation account, providing flexibility to allocate funding to the research stations and programs in response to emergent agency needs.

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[36] Washington Office Research & Development Staff Realignment Team. 2012. *Realignment Recommendations.* Internal Document, Washington, DC: United States Department of Agriculture: Forest Service.

[37] WO R&D requires each research station's activities to align with agency priorities by requiring the research programs/research work units of respective stations to operate under a charter or research work unit description. The charters and descriptions are not uniform in nature, and operate on varying timescales and evaluation intervals.; United States Government Accountability Office. 2010. "Forest Service Research and Development: Improvements in Delivery of Research Results can Help Ensure that Benefits of Research are Realized." Report to the Majority Leader, U.S. Senate, Washington, DC. https://www.gao.gov/assets/320/311854.pdf.

Field structure for Forest Service R&D and NFS

As noted above, Forest Service R&D's field structure is decentralized, organized in the form of five regionally focused research stations, the FPL that is national in scope and located in Madison, WI, and the International Institute of Tropical Forestry (IITF) located in San Juan, Puerto Rico (see Figure 1). The Forest Service research enterprise also maintains operations on 81 experimental forests and ranges.[38] The five research stations are the:

- **Northern Research Station (NRS)** – Connecticut, Delaware, Illinois, Indiana, Iowa, Maine, Maryland, Massachusetts, Michigan, Minnesota, Missouri, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, West Virginia, Wisconsin

- **Pacific Northwest Research Station (PNW)** – Alaska, Oregon, Washington

- **Pacific Southwest Research Station (PSW)** – California, Hawaii, U.S.-affiliated Trust Territories and nations of the Pacific

- **Rocky Mountain Research Station (RMRS)** – Arizona, Colorado, Idaho, Kansas, Montana, Nebraska, Nevada, New Mexico, North Dakota, South Dakota, Utah, Wyoming

- **Southern Research Station (SRS)** – Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia

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[38] United States Forest Service. December 2017. "Forest Service Research and Development Performance and Accountability Report - Fiscal Year 2016." United States Department of Agriculture, Washington, DC. https://www.fs.fed.us/sites/default/files/fs_media/fs_document/15937_fs_par_2016_508.pdf.
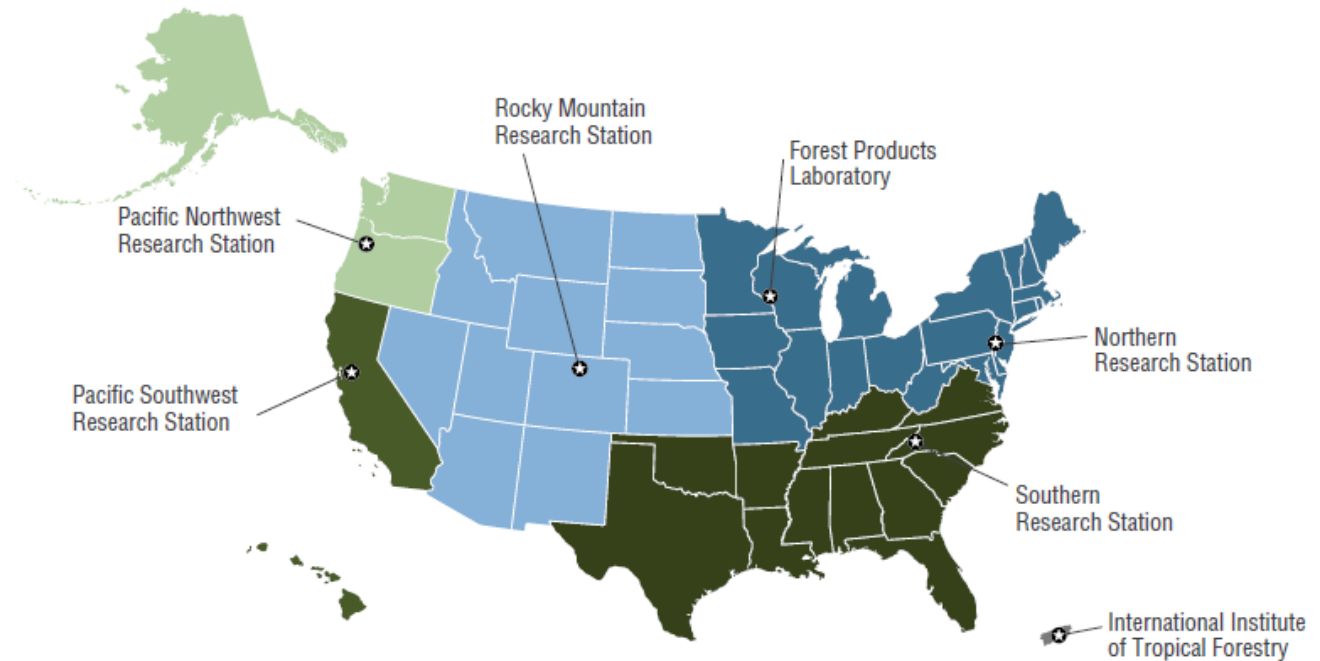
*Figure 1: Forest Service R&D Research Stations & Laboratories*

Not only is Forest Service R&D decentralized to meet the demands of differing geographies, it is also physically dispersed within geographies. Beyond the reporting relationships of the station directors to the Chief of the Forest Service, staff falling under the jurisdiction of a research station are often not located at the station itself. Rather, many staff members, researchers, and scientists in R&D operate in dispersed field sites across the geographical boundaries of their respective research stations. According to research conducted by the Government Accountability Office (GAO), "research itself is generally carried out at individual laboratories maintained by the research stations."[39] As referenced in the above sub-section on history, the Forest Service's structure was based on European models of forest administration, which were characterized by "a decentralized decision-making structure with considerable discretion given to field managers."[40] This, combined with limited access to communication in remote areas, set a historical precedent for the autonomy of researchers and land managers alike.

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[39] United States Government Accountability Office. 2010. "Forest Service Research and Development: Improvements in Delivery of Research Results can Help Ensure that Benefits of Research are Realized." Report to the Majority Leader, U.S. Senate, Washington, DC. https://www.gao.gov/assets/320/311854.pdf.

[40] MacCleery, Doug. 2008. "Re-Inventing the United States Forest Service: Evolution from Custodial Management, to Production Forestry, to Ecosystem Management." In *Re-Inventing Forestry Agencies: Experiences of Institutional Restructuring in Asia and the Pacific*, by Asia-Pacific Forestry Commission. Bangkok: Food and Agriculture

Forest Service R&D interacts with land managers and other staff outside its own deputy area through the nine NFS regions (see Figure 2), and S&PF's efforts across the United States.[41] Forest Service R&D research stations largely share the same footprint with corresponding NFS regions, with the exception of Rocky Mountain Research Station, which works with four NFS regions:

- Region 1: Northern Region

- Region 2: Rocky Mountain Region

- Region 3: Southwestern Region

- Region 4: Intermountain Region
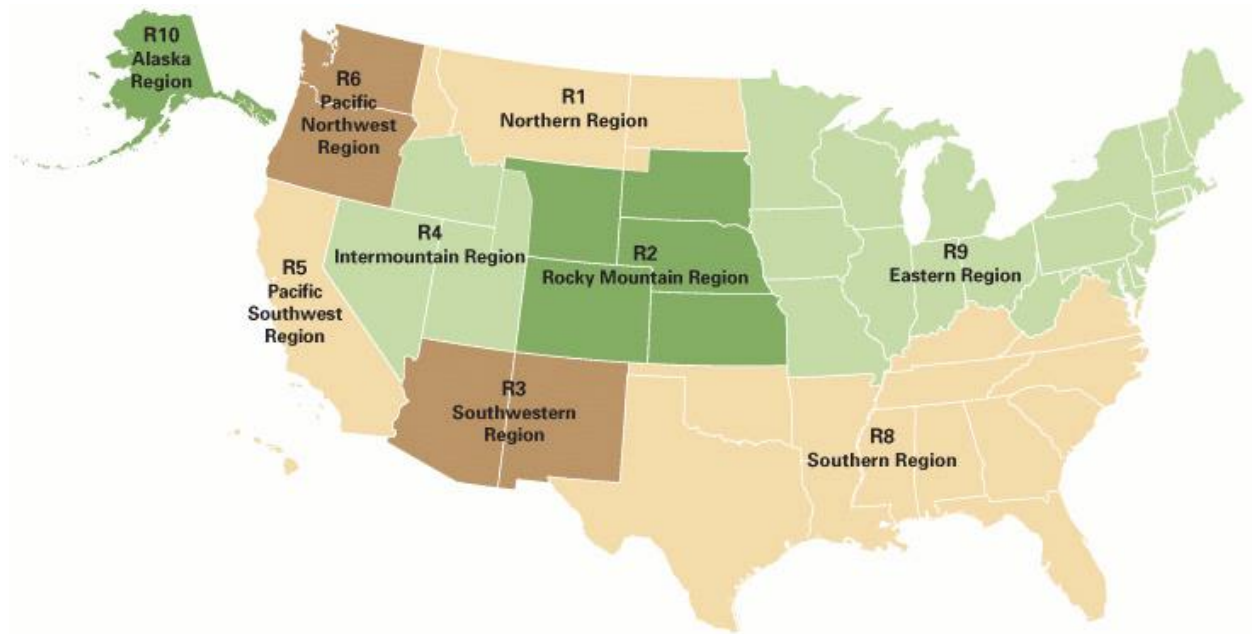
Figure 2: National Forest System Regions

The NFS regions are further divided into ranger districts, overseen by Forest Supervisors. There are over 600 ranger districts, each composed of a staff of 10 to 100 employees.[42] While the operations of Forest Service R&D and NFS are not mirrored one-for-one in the

Organization of the United Nations - Regional Office for Asia and the Pacific. http://www.fao.org/3/ai412e/AI412E06.htm.

[41] United States Forest Service. December 2017. "Forest Service Research and Development Performance and Accountability Report - Fiscal Year 2016." United States Department of Agriculture, Washington, DC. https://www.fs.fed.us/sites/default/files/fs_media/fs_document/15937_fs_par_2016_508.pdf.

[42] United States Forest Service. n.d. *Agency Organization.* Accessed August 13, 2019. https://www.fs.fed.us/about-agency/organization.

field, both are similarly decentralized. As in the case of Forest Service R&D's research stations, only a portion of NFS staff are housed at their respective regional offices.

Budget

As discussed above, funding for Forest Service R&D comes primarily through a single appropriation account.[43] In FY 2018, Forest Service R&D's total budget was approximately $300 million.[44] In recent years, R&D's share of the total Forest Service budget has held steady at about 4 percent,[45] but the relative shares of R&D's two research programs have changed. From FY 2017 to FY 2020, Forest and Rangeland programs declined from 67 to 62 percent of the R&D budget, while FIA increased from 21 to 27 percent.[46] The annual base funding request for Forest Service R&D is constructed through the solicitation of input from the research stations in prioritizing current and anticipated challenges in the management of natural resources.[47] In practice, funding is allocated to research stations largely based on their historical shares.[48]

While Forest Service R&D is by far the largest single funder and performer of forestry-related research, it operates within a larger research community. According to the U.S. Endowment for Forestry and Communities Blue Ribbon Commission on Forest and Forest Products Research & Development in the 21st Century, the total amount of funding for research in the United States forest sector is roughly $700 million a year. This includes $500 million coming from federal agencies, $150 million to $175 million from universities (largely from state legislature appropriations to state land grant universities and colleges), and $10 million to $15 million from nongovernmental sources. In addition to the Forest Service, other significant federal agency funders include the National Institute of Food and Agriculture (NIFA), which awarded $34 million in cooperative agreements

[43] United States Government Accountability Office. 2010. "Forest Service Research and Development: Improvements in Delivery of Research Results can Help Ensure that Benefits of Research are Realized." Report to the Majority Leader, U.S. Senate, Washington, DC. https://www.gao.gov/assets/320/311854.pdf.

[44] United States Forest Service. (2019). *FY 2020 Budget Justification.* Washington, DC. Retrieved from https://www.fs.fed.us/sites/default/files/media_wysiwyg/usfs-fy-2020-budget-justification.pdf

[45] United States Forest Service. 2019. "FY 2020 Budget Justification." Washington, DC. https://www.fs.fed.us/sites/default/files/media_wysiwyg/usfs-fy-2020-budget-justification.pdf.

[46] Dollars for FY2017 and FY2018 were actuals, while the dollars for FY2019 and FY2020 were estimated.

[47] United States Forest Service. December 2017. "Forest Service Research and Development Performance and Accountability Report - Fiscal Year 2016." United States Department of Agriculture, Washington, DC. https://www.fs.fed.us/sites/default/files/fs_media/fs_document/15937_fs_par_2016_508.pdf.

[48] Interviews with Forest Service R&D officials

to universities through the McIntire-Stennis Cooperative Forestry Program and the Agricultural Research Service (ARS) which spent $219 million internally on research in environmental stewardship in FY 2018, which encompasses watershed managmenet and conservation and restoration of range lands.[49,50] According to the National Research Council federal agencies other than the Forest Service were unable to provide definitive estimates of their funding for forestry research.[51]

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[49] National Association of University Forest Resource Programs. (2016). The McIntire-Stennis Cooperative Forestry Research Program 2017 Strategic Plan. Retrieved from http://naufrp.forest.mtu.edu/wp-content/uploads/2016/10/Mac_Stennis_StrategicPlan16PRINT.pdf

[50] United States Department of Agriculture. (2019). FY 2020 Budget Summary. Washington, DC. Retrieved from https://www.obpa.usda.gov/budsum/fy2020budsum.pdf

[51] Committee on National Capacity in Forestry Research - National Research Council. (2000). *National Capacity in Forestry Research.* Washington, DC: National Academy Press.; The Deparement of Energy, Environmental Protection Agency, Deparment of Interior, and National Science Foundation were able to identify funding in this area, but were unable to provide definitive estimates.

Section 3: Integrating R&D and Agency Partners

The mission of the Forest Service depends on a solid research foundation to understand the complex issues related to improving the health and productivity of the Nation's forest and grasslands. Useful research products and services are produced through effective interactions between R&D scientists and its knowledge users (i.e., agency staff and external stakeholders) and aligned with the mission needs of its key internal customers, including the NFS and State and Private Forestry deputy areas. Both sides—Forest Service R&D and NFS—must be responsible for cultivating a dynamic relationship between science and agency mission needs.

Historically, Forest Service R&D has not focused consistently on the integration of science with agency decisions. This stems in part from the training of scientists and is a common challenge in managing R&D in federal government. In recent years, individual research stations started experimenting with a more collaborative approach to coordinating with agency partners to identify research needs. However, there appears to be no formalized, systematic approach to integrating research with agency mission needs at the regional level.

Further, Forest Service R&D has not always been included in the agency's policy and management discussions, sometimes resulting in poorly informed policy decisions and unnecessary conflicts. The Forest Service is a science-based agency; however, in some cases, agency decisions have been made without consulting Forest Service R&D. Examples of lack of engagement exist at both region and HQ level.

Leading Practice Suggests a Collaborative Approach to Science Production and Delivery to Support Agency Mission Goals

This section provides a summary of leading practices in science-agency integration. Previous studies highlight the importance of cultivating and sustaining a productive relationship between science and government policy and management decisions.[52] Scientific research plays an increasingly important role in governmental policy decision-making process. However, a common concern in federal science agencies is the tendency for scientists or decision makers to act alone. The culture of a research organization is

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[52] Bednarek, A.T., C. Wyborn, C. Cvitanovic, R. Meyer, R.M. Colvin, P.F.E. Addison, S.L. Close, et al. 2018. "Boundary spanning at the sceince-policy interface: the practitioners' perspectives." *Sustainability Science* 13. doi:https://doi.org/10.1007/s11625-018-0550-9.

very different from that of their parent agency. The integration of scientific research with policy decisions requires a change in mindsets—a cultural change.

Integrating science into an agency's decision making-process is a comprehensive and inclusive process. "Science best meets the needs of decision makers when those needs are considered throughout the institutions, policies, and processes that comprise the scientific enterprise."[53] First of all, scientists should work closely with knowledge users from the beginning of the science process to understand their research needs and, where possible, incorporate their needs into research plans.[54] Some researchers describe this process as "co-production of science."[55] The interactions between researchers and agency partners should precede the initiation of research projects. According to the Executive Office of Science and Technology Policy, "in order to maximize the societal benefits of R&D investments, research planning and design should be guided by stakeholder and user engagement."[56] Agency knowledge users offer insights to identify research needs, shape research questions, and clarify study scope and methodology, while scientists bring expertise to ensure that research design is feasible and follows scientific research principles. The purpose of co-producing science is to align research with agency mission needs when that is not inimical to research standards and ensure that research addresses the right questions, produces useful outcomes in a timely and efficient manner, and informs agency decisions.

Co-production of science is an interactive process and requires more than one meeting.[57] A key component of co-production of science is the ongoing, regular interactions between scientists and knowledge users. Effective scientific products to support agencies' decision

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[53] Science Policy Assessment and Research on Climate. 2010. *Usable Science: A Handbook for Science Policy Decision Makers*. Consortium for Science, Policy & Outcomes. https://cspo.org/wp-content/uploads/2018/09/Usable-Science.pdf.

[54] Clark, William C., Lorrae van Kerkhoff, Louis Lebel, and Gilberto C. Gallopin. 2016. "Crafting usable knowledge for sustainable development." Edited by B.L. Turner. *Proceedings of the National Academy of Sciences* 113 (17): 4570-4578. doi:https://doi.org/10.1073/pnas.1601266113.

[55] Actionable Science Work Group Advisory Committee on Climate Change & Natural Resource Science. 2015. "Guiding Principles and Recommended Practices for Co-Producing Actionable Science: a How-To Guid for DOI Climate Science Centers and the National Climate Change and Wildlife Science Center."

[56] Holdren, John P., and Shaun Donovan. 2015. "Multi-Agency Science and Technology Priorities for the FY 2017 Budget." *Memorandum for the Heads of Executive Departments and Agencies.* Washington, DC: Executive Office of the President: Office of Science and Technology Policy, July 9. https://obamawhitehouse.archives.gov/sites/default/files/microsites/ostp/m-15-16.pdf.

[57] Bednarek, A.T., C. Wyborn, C. Cvitanovic, R. Meyer, R.M. Colvin, P.F.E. Addison, S.L. Close, et al. 2018. "Boundary spanning at the sceince-policy interface: the practitioners' perspectives." *Sustainability Science* 13. doi:https://doi.org/10.1007/s11625-018-0550-9.

making process are not simply produced by scientists and then provided to agency staff. Quality products do not necessarily "speak for themselves." Knowledge users, especially those who do not have extensive scientific background, require assistance in using the information effectively. Co-producing science is a comprehensive process, and the process is as important as the final scientific products.[58]

In addition to science production, it is also critical to engage agency partners in the science delivery process to present and communicate research outcomes in a way that meets the needs of knowledge users. Many studies have concluded that effective science communication requires scientists to understand the perspectives of their audiences, how they process information, and the environment in which they work.[59] In the case of the federal government, scientific research findings should be communicated in a form that can be digested and used by agency policy makers who work in a politically-charged environment and under short time constraints, often do not have scientific backgrounds, and do not require detailed information on every aspect of an issue. Additionally, science delivery encompasses not just the communication of results, but also the development of applications and decision-support tools to facilitate the use of scientific results.

Finally, experts on scientific enterprises offer important insights on how to disseminate research information effectively through multiple channels. For example, in his article *How Today's Professionals Prefer to Find the Science They Need to Do Their Jobs*, Dr. Richard Guldin finds that online searching is the most common way for people to find scientific information; webinars and short videos are also popular formats to present research findings; and many professionals still prefer to attend scientific meetings and conferences to learn about new development in their fields.[60]

Some scholars define the practices of science-policy interface as "boundary spanning"— i.e., "work to enable exchange between the production and use of knowledge to support evidence-informed decision making in a specific context."[61] While there is no one best

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[58] Ibid

[59] Peha, Jon M. 2001. "Bridging the Divide Between Technologists and Policy-Makers." *Speakout: IEEE Spectrum.* Carnegie Mellon University, March. https://users.ece.cmu.edu/~peha/bridging_divide.pdf.; Cairney, Paul, and Richard Kwiatkowski. 2017. "How to communicate effectively with policymakers: combine insights from psychology and policy studies." *Nature* (Palgrave Communications). doi:DOI: 10.1057/s41599-017-0046-8.

[60] Guldin, Richard W. 2018. "How Today's Professionals Prefer to Find the Sceince They Need to Do Their Jobs." *Journal of Forestry* (Society of American Foresters) 116 (5): 451-459. doi:https://doi.org/10.1093/jofore/fvy036.

[61] Bednarek, A.T., C. Wyborn, C. Cvitanovic, R. Meyer, R.M. Colvin, P.F.E. Addison, S.L. Close, et al. 2018. "Boundary spanning at the sceince-policy interface: the practitioners' perspectives." *Sustainability Science* 13. doi:https://doi.org/10.1007/s11625-018-0550-9.

approach for building and maintaining effective interface between science and decision making, previous studies offer some general guiding principles:

- An effective boundary-spanning function requires sufficient time, resources, and expertise (in some cases, full-time attention is needed), as opposed to collateral duty assignments.

- Scientists may take on the boundary spanning responsibilities; however, it is important to recognize that the skills required for effective boundary spanning, such as engaging policy makers, navigating politics, facilitating discussions, etc., are very different from the skills required to conduct scientific research, and therefore, training and professional development opportunities are necessary to develop and nurture skills in boundary spanning. [62,63] It is also critical to identify good candidates with the skills and personalities for the "boundary spanning" roles. Not all scientists are interested in taking on the responsibilities of facilitating the collaboration between researchers and agency partners.[64]

- It is important to establish the incentive structure and career tracks to encourage science-policy integration. Performance measures that reflect boundary-spanning activities should be built into job descriptions and performance reviews.[65] Yet traditional academic performance measures in research agencies do not encourage science-policy interface.[66] As Dilling and Lemos argue, "while scientific merit is

[62] Cairney, Paul. 2016. *The Politics of Evidence-Based Policy Making.* London: Palgrave MacMillan. https://www.palgrave.com/gp/book/9781137517807. ;
American Association for the Advancement of Science. 2017. "Connecting Scientists to Policy Around the World: Landscape Analysis of Mechanisms Around the World Engaging Scientists and Engineers in Policy."
[63] Clark, William C., Lorrae van Kerkhoff, Louis Lebel, and Gilberto C. Gallopin. 2016. "Crafting usable knowledge for sustainable development." Edited by B.L. Turner. *Proceedings of the National Academy of Sciences* 113 (17): 4570-4578. doi:https://doi.org/10.1073/pnas.1601266113.
[64] Bednarek, A.T., C. Wyborn, C. Cvitanovic, R. Meyer, R.M. Colvin, P.F.E. Addison, S.L. Close, et al. 2018. "Boundary spanning at the sceince-policy interface: the practitioners' perspectives." *Sustainability Science* 13. doi:https://doi.org/10.1007/s11625-018-0550-9.
[65] Actionable Science Work Group Advisory Committee on Climate Change & Natural Resource Science. 2015. "Guiding Principles and Recommended Practices for Co-Producing Actionable Science: a How-To Guid for DOI Climate Science Centers and the National Climate Change and Wildlife Science Center.".
[66] Science Policy Assessment and Research on Climate. 2010. *Usable Science: A Handbook for Science Policy Decision Makers.* Consortium for Science, Policy & Outcomes. https://cspo.org/wp-content/uploads/2018/09/Usable-Science.pdf.

paramount as evaluation criteria of any research activity, it may be necessary to add a second dimension in the case of co-produced science."[67]

Earlier research provides a number of case studies on the efforts to adopt explicit processes to engage agency knowledge users early in the process to co-produce science. For example, interviewees from the National Oceanic and Atmospheric Administration (NOAA) emphasized the importance of bringing together scientists and agency partners to produce usable research and support the agency's mission. The NOAA Fisheries, one of the six line offices of NOAA, has established a formal, joint planning process to engage scientists, agency resource managers, and budget staff in developing annual strategic priorities.[68] Building on the annual priority setting process, NOAA Fisheries recently implemented a 5-year strategic planning process at the regional level. Similarly, the regional strategic plan also relies on a collaborative process that involves both regional science organizations and regional regulatory organizations. NOAA interviewees recognized the cultural conflicts between research organizations and their agency partners and noted that there are some mechanisms or practices that can help encourage science-agency collaboration. For example, opportunities for rotation assignments/sharing staff can be an effective tool that encourages an enterprise-wide focus and creates more permeable boundaries between research organizations and agency partners.

Since this regional planning effort is new, planning processes and practices vary across regions. According to NOAA interviewees, the goal is to gradually implement some standardized processes and planning tools. NOAA officials emphasized the importance of maintaining the right balance between enforcing standard processes and allowing regions some flexibilities to address their specific needs. Pushing too hard too soon on standardizations can encounter resistance from regions and create an "us" versus "them" mentality.

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[67] Lisa, Dilling, Carmen Maria, and Lemos. 2011. "Creating Usable Science: Opportunities and Constraints for Climate Knowledge Use and Their Implications for Science Policy." *Global Environmental Change* 21 (2). doi:DOI: 10.1016/j.gloenvcha.2010.11.006.

[68] The National Marine Fisheries Service, also known as NOAA Fisheries, is one of the six NOAA line offices responsible for the stewardship of the nation's ocean resources and their habitat.

Efforts Underway to Strengthen the Integration of Forest Service R&D and Agency Mission Needs

Efforts to develop a collaborative approach to science production and delivery

Forest Service R&D leaders at both HQ and the research stations have recognized the importance of ongoing, meaningful interactions between research station scientists and NFS managers and staff. Some research stations have taken actions to work with agency partners to produce research products and disseminate research information. This section offers two examples of effective agency-research collaborations cited by many NFS and research station staff in our interviews. First, PNW developed its Science Synthesis report through a systematic engagement with the Forest Service land managers and other stakeholders. The Synthesis Report provides a review of scientific literature published since 1994 to inform land management within the Northwest Forest Plan (NWFP) area and support the NWFP area's management planning efforts. Another example is the *Southern Forest Futures Project*, which was initiated in 2008 and designed to inform stakeholders and policy makers about possible scenarios for land use, forest conditions, and forest uses in the South[69] over the next 50 years. It also represents an extensive collaboration among SRS scientists, Region 8 staff, and the Southern Group of State Foresters. The *Southern Forest Futures Project* inspired subsequent development of the Northern Forest Futures Project. These forest future projects are perceived by many stakeholders as successful collaboration efforts between scientists and agency partners.

A recurring theme in conversations with research stations was that what agency partners often need is not new research, but reorganizing existing research information to make it more "usable" by agency managers and staff. In addition to peer-reviewed publications, some research stations have designed a range of products to present existing research in an easily digestible and useful format. For example, SRS developed webinars, podcasts, and online courses to present research findings to NFS staff. PNW hosted technical webinars to help land and resource managers understand the potential implications of the findings of the Synthesis Report and facilitate in-depth discussions. The RMRS sends out a bimonthly *Science You Can Use* Bulletin to provide synthesized scientific information for high-priority management needs. Other examples of RMRS' research products (in

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[69] United States Forest Service: Southern Research Station. 2013. "Chapter 1: Design of the Southern Forest Futures Project." In *Southern Forest Futures Project Technical Report*, by David N. Wear and John G. Greis. Asheville. https://www.srs.fs.usda.gov/pubs/44183.

addition to journal publications) include one-page research project overviews and Science Spotlights (summaries of scientific journal articles).

Additionally, research stations' efforts to improve science delivery go beyond simply providing useful research information. "Actionable science is not only actionable information, but also a process for the appropriate use of that information."[70] Some stations work collaboratively with NFS staff to develop tools and applications to facilitate the use of scientific information. For instance, SRS developed a range of datasets, software, applications, and models, such as the Forest Inventory Data Online, a satellite-based overview of potential forest disturbances, story maps, and a mobile app for identifying invasive plants, to deliver research findings and support NFS managers and the public.

Multiple communication channels, including publications, websites, newsletters, blogs, workshops, and social media, have been utilized by research stations to disseminate scientific information to different audiences. There is not a "one-size-fits-all" approach when it comes to science information dissemination. The Forest Service Strategic Plan (FY2015-2020) emphasizes the value of "effective ways of communicating resource data and new knowledge and making it widely available, using social media, publications, the internet, and other tools that have a global reach for disseminating information."[71]

Efforts to formalize researcher-land manager collaborations to address strategic issues at the regional level

Interviewees pointed out that research station scientists developed grassroots science-manager relationships as needed to work on specific issues and projects; however, existing relationships are mostly personality driven and are established as opportunities arise, and many argued that what is missing is more systematic and strategic collaboration between research stations and NFS staff at the regional level.

Interviewees highlighted several well-received efforts to elevate the collaborations between scientists and NFS staff. For example, SRS has hosted seven State Line Meetings since 2012 to bring together state foresters from adjacent states to share current and future research projects, identify areas of cooperation, discuss forest management related issues

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[70] Actionable Science Work Group Advisory Committee on Climate Change & Natural Resource Science. 2015. "Guiding Principles and Recommended Practices for Co-Producing Actionable Science: a How-To Guide for DOI Climate Science Centers and the National Climate Change and Wildlife Science Center."
[71] 2015. "USDA Forest Service Strategic Plan: FY 2015-2020." Washington, DC, June. https://www.fs.fed.us/sites/default/files/strategic-plan[2]-6_17_15_revised.pdf.

and concerns, and how SRS can assist in resolving these issues.[72] In addition, since 2017, SRS has held two or three Green Line Meetings a year, which were modeled after State Line Meetings, to "create strategic connections between SRS scientists and NFS managers."[73] Green Line meetings offer the opportunity for SRS scientists to meet with NFS managers to share research highlights, focus on research topics that are important to NFS staff, identify regional research needs and determine potential areas for collaboration between SRS staff and NFS managers. Both State Line meetings and Green Line Meetings are intended to engage agency partners and external stakeholders at the regional level (as opposed to state-by-state and forest-by-forest).

Another example of strengthening the science-agency mission connection is the Rocky Mountain Research Station's recent effort to establish interdisciplinary Regional Science Advisory Teams (RSATs). The primary purpose of RSATs is to facilitate regular, strategic interactions between the station scientists and regional staff and address the strategic research needs at the regional level (one team for each region). Each advisory team is made up of six to eight RMRS scientists and six to eight regional managers, and has regular in-person and telephone meetings to discuss progress and address emerging issues. RMRS issued a set of general operating guidelines, and each team can adjust these principles based on its needs. RSATs are in early stages, and processes vary significantly across regions. The study team was told that Regions 2 and 3 have made the most progress, and they are in the process of identifying strategic issues in their regions. Interviewees noted that RMRS' scientists and NFS staff have built relationships over time, but most of those interactions were sporadic, and RSATs are part of the research station's efforts to institutionalize and strengthen those existing grassroots relationships.

Challenges to Effective Customer Engagement Exist

In this section, the Panel focuses on two types of challenges facing Forest Service R&D as they attempt to adopt a more collaborative approach to engaging agency partners: the challenges at the research station level and the challenges at the regional/enterprise level.

Challenges to developing a collaborative science production and delivery approach
Individual research stations' efforts to integrate scientific research with the agency's mission needs appear to be headed in the right direction; however, most of these efforts

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[72] 2019. *Southern Group of State Foresters and Southern Research Station State Line Meetings* . https://www.srs.fs.usda.gov/stateline/.

[73] Laseter, Stephanie. 2017. "Inaugural Green Line Meeting." *United States Forest Service: Southern Research Station - CompassLive.* May 24. https://www.srs.fs.usda.gov/compass/2017/05/24/inaugural-green-line-meeting/?doing_wp_cron=1567180345.8398039340972900390625.

are still in early stages, and their effectiveness and outcomes are uncertain. It is not clear how the interactions between scientists and NFS staff affect research stations' decision-making process. In many cases, processes and mechanisms to ensure that NFS and stakeholders' input on research priorities are integrated into research plans are not evident.

Routinely connecting research with agency mission needs requires changes in the incentive structures of R&D scientists. A key element of this incentive structure is the performance evaluation system for scientists in the federal government, which is informed by the Research Grade Evaluation Guide (RGEG) maintained by the federal Office of Personnel Management (OPM).[74] RGEG is the government-wide reference for scientific research positions, which provides the criteria for evaluating the grade level of research work for grades 11 through 15. R&D utilizes the OPM guide, in addition to the supplemental "Forest Service Guide for Preparing Research Scientist Position Descriptions and Conducting Research Grade Evaluation Panels" (2012).

With inherent differences in mission and structure, each agency using the RGEG has evolved slightly different methods for preparing a scientist's position description and evaluating the grade level of a research position. Forest Service R&D shares similar RGEG processes to agencies such as ARS, USDA Economic Research Service, USDA Natural Resources Conservation Service, and the U.S. Geological Survey.

Many interviewees expressed the belief that the RGEG limits R&D's ability to integrate science and the agency's policy and management decisions. However, the study team's research indicates that RGEG itself does not necessarily represent a challenge. The key issue is how RGEG is interpreted and implemented. Agencies are not required to solely rely on RGEG for performance evaluation. In other words, RGEG can be supplemented by other types of performance metrics or grading criteria that allow an agency to more effectively evaluate the quality and outcome of research work. The RGEG states:

> "The nature, type, importance, and significance of various professional contributions, research products, and other scientific outputs vary across agencies and disciplines. Therefore, agencies may find it helpful to develop supplements to this guide to aid in evaluating research work in their specific research environments."[75]

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[74] RGEG provides grading criteria for nonsupervisory professional research work in the engineering and biological, medical, agricultural, physical, mathematical, and social sciences occupational groups for General Schedule and other "white collar" pay plans.; United States Office of Personnel Management. 2006. "Research Grade Evaluation Guide." September.

[75] Ibid

Some agencies take a broader approach to performance evaluation. For example, NOAA developed performance plans that reflect traditional academic performance (e.g., the number and citation impact of publications) as well as outcomes that relate to the mission and goals of the agency.

The study team learned that, as part of the performance evaluation process, Forest Service R&D scientists are supposed to demonstrate how their work contributes to the agency's mission needs; however, in practice, as interviewees explained, it is difficult to identify performance metrics that reflect the outcomes or impacts of research.

A related issue is the panel evaluation system for determining grade levels for scientists.[76] The work of federal government scientists is evaluated by a panel of peer scientists. According to OPM's RGEG guidance, the evaluation panel should be staffed "by both researchers to provide critical subject matter expertise and human resources specialists to collaborate and to build consensus for the grade level determination;" and "include disciplinary diversity to provide better perspective with respect to the relationship of the specific work of the position to broader areas of research."[77] At Forest Service R&D, an evaluation panel consists of four rating members, including two panelists from related research fields to serve as subject matter experts and two scientists selected from other fields of research to represent a broader research perspective. In addition, the evaluation panel should include two non-rating members—a panel chair and a Human Capital Specialist.

In 2015, a team was convened to review the Forest Service RGEG panel process. The team summarized a set of issues and proposed recommendations to the Forest Service Research Executive Team (FSRET). As a result, FSRET approved and established the Research Grade Evaluation Task Group to implement recommendations. One of the recommendations was to update the 2012 Forest Service Supplemental Guide. The updated guidance will provide direction for important clarifications and updates in the content of position descriptions and in the evaluation processes in order to ensure consistency across FS R&D; to award proper credit for team research assignments and accomplishments; to reinforce the importance of technology transfer; to define

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[76] Evaluation panels shall be used to provide Human Resources Specialists with technical advice and counsel needed to assign correct grade levels for professional research positions evaluated by the RGEG

[77] According to the the Forest Service RGEG Panel Handbook, Panel chairs shall be experienced panelsists and need not be from the same or related discipline as the scientist whose position is being evaluated.; 2017. "Classification of Positions Under the Scientist Career Plan." *Position Classification Handbook.*

expectations; and to emphasize the importance of evaluating the overall quality, usefulness, impact, and significance of a scientist's accomplishments. [78]

Interviewees highlighted two concerns about the panel review process. First, given the challenge of identifying outcome metrics, some panelists, especially those who are from other research fields, tend to primarily rely on output measures (e.g., the number of publications) to evaluate job performance and determine grade levels of scientist positions (i.e., promotion, remain in grade, or demotion). Additionally, the panel process is peer based and appears to be somewhat arbitrary. It is difficult to ensure that a panel has the right mix of reviewers. As some interviewees pointed out, to some degree, the challenge is not the RGEG or performance metrics, but the mindset of some panelists, who put greater emphasis on scientific research, as opposed to the contribution of the research to agency mission needs. A cultural shift is needed to address panel bias toward publications.

Recommendations

To facilitate effective interface between research stations and NFS, the Panel offers the following recommendations:

- *Recommendation 3-1*: **Provide training and career development opportunities to enable staff to build the skills to engage agency partners**. As discussed in the Leading Practices section, effective science-agency interface requires a different set of skills (e.g., the ability to communicate scientific information to non-scientists, the ability to work effectively with agency staff in a political environment, and the ability facilitate cooperation and communication) from traditional scientific research. R&D should conduct a training needs assessment to identify the important skills required to facilitate scientists-agency interactions and determine skills gaps in the organization.
- *Recommendation 3-2*: **Design career tracks and provide career advancement opportunities to reward employees who desire to take on "boundary spanning" responsibilities and encourage research-agency integration**.
- *Recommendation 3-3*: **Develop performance metrics that emphasize the contribution of research to agency's mission to supplement the Research Grade Evaluation Guide**. Scientists should be held accountable for engaging agency partners and strengthening the connection between research and agency mission needs.

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[78] The updated guide is in final review.

- *Recommendation 3-4*: **Review its panel evaluation process and identify opportunities for improvement**. One potential option is to require that each review panel include at least one rating member selected from non-R&D technical staff (e.g., National Forest System technical staff) to emphasize the contribution of research to agency mission needs and enhance research-agency integration.
- *Recommendation 3-5*: **Conduct an annual survey to measure agency partner satisfaction with R&D's products and support and identify opportunities for improvement**. [79]

Challenges of implementing collaborative, Region-level research planning processes across the enterprise

As discussed earlier, some individual Research Station such Southern and Rocky Mountain have taken steps to institutionalize collaborative, Region-level research planning processes. However, it is not clear how Forest Service R&D will leverage the local efforts of research stations and proceed from individual efforts to a more systematic, institution-wide approach to engaging agency partners. The study team's research highlights two barriers to implementing an enterprise level collaborative approach: (1) cultural differences between Forest Service R&D and NFS; and (2) their decentralized structures.

First, establishing a strategic connection between scientists and agency decision makers requires a culture shift in the Forest Service. "The worlds of science and society are far apart culturally and epistemologically, and thus directing interaction between them is challenging."[80] Multiple interviewees highlighted the cultural conflicts between Forest Service R&D and NFS. Forest Service R&D operates more like a university with a strong academic culture, and scientists tend to focus on their research. By contrast, like other government agencies, NFS has a traditional top-down hierarchical culture and structure emphasizing "command and control." When making decisions, agency policy makers need to take into account a range of factors (such as political pressure) in addition to scientific information. As some interviewees described, Forest Service R&D and NFS have different priorities, challenges, decision-making processes, and incentive structures, and as a result, some research stations' efforts to strengthen scientists-agency manager

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[79] R&D conducts a Customer Satisfaction Survey triennially. The survey is sent to both internal and external customers. However, the results are not broken out for internal customers (e.g., National Forest System and State and Private Forestry).

[80] McNie, Elizabeth C. 2007. "Reconciling the supply of scientific information with user demands: an analysis of the problem and review of the literature." *Environmental Science & Policy* 10 (1): 17-38. doi:https://doi.org/10.1016/j.envsci.2006.10.004.

collaborations met initial resistance from both sides. It is challenging to foster an environment in which players with different interests and motives work effectively with each other.

In addition, some interviewees explained that the historical disconnect between Forest Service R&D and NFS was partly intentional. Scientists tend to work at arm's length from NFS staff to ensure the independence of their research. It is important to maintain the balance between scientific independence and the need to be responsive to agency partners. There has been a growing recognition that the primary goal of Forest Service R&D is to support the agency's mission needs.   It is a top priority for the new Deputy Chief for Forest ServiceR&D to work with agency leaders to integrate Forest Service R&D into the agency's planning and decision making processes. However, "collaboration is a byproduct of culture."[81] It will take time to build relationships and shift an organizational culture.

The decentralized structure of both Forest Service R&D and the Forest Service presents another collaboration challenge. On one hand, Forest Service R&D research stations operate with a high degree of independence and autonomy, and each research station has its own process, rules, and identity. There are no reporting relationships between the Deputy Chief for Forest Service R&D and research station directors, so WO R&D does not have direct control over the collaboration efforts of research stations or the authority to impose policy requirements to establish a more consistent collaboration approach across the organization.

Despite these limitations, R&D has taken some actions to develop a more systematic collaboration with agency partners. For example, beginning in FY 2020, research stations (i.e., station directors) and regions (i.e., regional foresters) will jointly develop and submit shared research priorities based on the needs of the National Forests and state and private partners.

From NFS' perspective, Forest Service R&D's decentralized organization is also viewed as an obstacle to engaging scientists in the agency's decision making process. It is sometimes difficult for NFS staff to figure out whom to contact when they need scientific advice or want to invite Forest Service R&D to agency's policy and management

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[81] Razzetti, Gustavo. 2019. *The collaboration trap: Why we assume teams like working together.* March 16. https://www.theladders.com/career-advice/the-collaboration-trap-why-we-assume-teams-like-working-together.

discussions. It is not always clear who can speak for Forest Service R&D on different issues at both regional level and enterprise level.

Additionally, given the diverse research needs of different regions, it is difficult to develop targeted messages and effective customer engagement strategies. Some research stations (e.g., RMRS) serve multiple regions, and it requires different collaboration strategies to meet the diverse research needs of regional partners.

Further, NFS is not the only user of Forest Service R&D's research in the agency. Some interviewees reported that their organizations do not have regular communications with Forest Service R&D. They provide funding to support Forest Service R&D, but it is not clear how R&D's work contributes to their mission needs. The Forest Service lacks a systematic process to identify all primary knowledge users within the agency and build a collaborative relationship with them.

Recommendations

To build on the local efforts of research stations and institutionalize a consistent approach to engage agency partners at the regional level, the Panel offers the following recommendations:

- *Recommendation 3-6*: **Treat RMRS' RSAT effort as a pilot project for a new approach to regional collaboration**. RSATs provide a promising model for translating ad-hoc research-NFS collaborations into a more systematic, institutionalized relationship. RSATs are still in early stages, and R&D should establish a formal process to evaluate the benefits, costs, and risks associated with this effort and test applicability enterprise-wide. Pilot testing will assist R&D leadership in identifying the general elements of an effective enterprise-wide policy guidance.
- *Recommendation 3-7*: **Hold an annual conference to bring together representatives from research stations, NFS, and other agency stakeholders to provide networking opportunities, encourage cross-research station collaboration, and serve as a community of practice for the integration of science and agency policy decisions**. The Deputy Chief R&D should host this annual conference and set the agenda.
- *Recommendation 3-8*: **Issue policy guidance to institute a more systematic, institution-wide approach to engaging agency partners throughout the lifecycle of most, if not all, research projects**. The Panel recognized that the Deputy Chief R&D does not have direct line authority over research stations and mostly relies

on an "influence and persuasion" type of leadership approach. The purpose of the policy guidance is to provide some general principles that research stations should follow when they establish their own processes to integrate scientific research with agency policy decisions. However, this does not mean that all research stations should establish their collaboration process in the exact same way. Given their diverse research needs, flexibility is essential for research stations to carry out its functions effectively. Each research station should adapt the guidance based on their specific needs and environment.

Section 4: Improving Enterprise-level Communications

In this section, the Panel provides guidance on how to improve communication with internal and external stakeholders of Forest Service R&D enterprise. Opportunities to address these communication challenges are discussed within a framework for implementing a broader, ongoing process of organizational learning and alignment tailored to the particular circumstances of Forest Service R&D.

Communication Challenges

The Panel focuses on communication challenges in four areas:

1. R&D investment priorities and resources allocation
2. How the research stations fit within an R&D enterprise strategy
3. The value of research and how it fits into the broader array of R&D activities
4. R&D contributions to the Forest Service's mission

R&D investment priorities and resource allocation

In interviews, stakeholders expressed a strong belief in the importance of R&D to the performance of the Forest Service mission. At the same time, they expressed concern that R&D was not allocating available Forest and Rangeland Research resources to achieve the greatest mission impact. This concern stems in part from: (1) a failure to clearly explain research priorities; and (2) a lack of transparency in how resources are allocated to achieve those priorities.

Until recently, R&D identified Priority Research Areas in the budget requests (FY 2017-FY 2019), and in Performance and Accountability Reports for FY 2014-2016 mandated by Congress. However, these documents provide little or no explanation of these priorities, how they were developed, why they changed or how they relate to advancing mission objectives. Also, it is not clear how these priorities informed the allocation of budget resources. In the the Forest Service budget justifications for FY 2017 through FY 2019, R&D provided a budget matrix table to map its Strategic Program Areas (SPAs) to its Priority Research Areas (PRAs). However, the matrix described how funds were being used after allotment rather than informing how resources were allotted.

Also, there appears to have been some confusion about the nature of priorities. As can be seen in Figure 3 below, the seven PRAs together account for the total appropriated funds for research. In other words, the entire budget is presented as priority spending.

Confusingly, one of the seven research priorities is titled "localized research," which accounted for most of the total allocation.[82] Absent a clear explanation of this category, some stakeholders interpreted this as a catch-all category for other work being done by individual stations that was simply being called a priority.

FY 2017 Priority Research Areas and Strategic Program Areas Matrix Funding Table
(dollars in thousands)

Priority Research Areas	Strategic Program Areas							Total
	Fire	Invasives	Recreation	Resource Mgmt. & Use	Water, Air, & Soil	Wildlife & Fish	Inventory & Monitoring	
Forest Disturbances	$277	$188	$0	$14,588	$1,906	$2,987	$5,104	$25,000
Forest Inventory and Analysis	$0	$0	$0	$0	$0	$0	$77,000	$77,000
Watershed Mgmt. and Restoration	$1,745	$1,134	$0	$2,812	$9,198	$5,670	$863	$21,422
Bioenergy and Biobased Products	$231	$91	$0	$10,827	$231	$0	$322	$11,702
Urban Natural Resource Stewardship	$436	$0	$1,969	$1,033	$1,308	$0	$872	$5,618
Nanotechnology	$0	$0	$0	$4,318	$0	$0	$0	$4,318
Localized Research	$18,097	$31,514	$2,180	$54,011	$20,552	$16,789	$729	$143,872
Subtotal	$20,786	$32,927	$4,149	$87,589	$33,195	$25,446	$84,890	$288,982
Extramural Research Support (JFSP)	$0	$0	$0	$0	$0	$0	$3,000	$3,000
Total	$20,786	$32,927	$4,149	$87,589	$33,195	$25,446	$87,899	$291,982

Figure 3: Forest Service R&D Matrix Funding Table

As noted in Section 2, the new Deputy Chief for R&D has developed a new framework for organizing and communicating R&D activities, which includes four research priorities, three foundational research areas, seven discipline areas, and three types of R&D deliverables. Unlike the Priority Research Areas, the four research priorities are intended to directly inform the allocation of discretionary R&D funds at the national level. Study team discussions with R&D about earlier versions of this framework suggest the potential for greater transparency. However, the study team was not able to fully assess the new framework.

Stakeholders also expressed concern about the lack of transparency in the allocation of resources to universities. According to interviews, approximately $50 million of the total R&D budget annually went to fund research at universities in recent years. However, information is not readily available that documents the rationale for deciding to fund research at universities instead of in-house, the choice of university performers, and how the work tracks with research priorities. Stakeholders expressed concern that decisions about funding university research are driven more by relationships than by strategic assessments of capability and performance.

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[82] The category was retitled "National Forest System Lands Research" in requests subsequent to FY 2017.

How the research stations fit into an R&D enterprise strategy

A strength of Forest Service R&D is its regional organization, which enables it to respond to the needs of different geographic regions that reflect differences in forests and terrain, patterns of land ownership and economies. Research on mission challenges like fire risk mitigation must be tailored to the distinctive regional circumstances because the associated risks and mitigation strategies differ significantly between geographies. Upon looking across the research portfolios of the research stations, it is easy to think that there might be duplication of effort. However, what appears to be duplication of effort upon initial examination of readily available information and messaging actually may be reasonable investments in meeting distinctive needs. Simultaneously, some research stations have developed cross-cutting capabilities and function informally as national centers of excellence.

The value of research and how it fits into the broader array of R&D activities

Research is critical to provide the fundamental understanding of natural phenomena and processes needed to efficiently and effectively address many current and future mission challenges. However, pressure to undertake more applied research and focus on delivering existing science to meet near-term needs raises concerns about how to maintain support for basic research. Moreover, for many of R&D's internal agency partners, station research is associated with a university-style approach to research with little attention to addressing mission challenges.

R&D's contribution to the Forest Service mission

NFS officials generally do not visit Congress with research station staff, though there have been isolated instances of strong relationships between regional and station partners. One such relationship, the Northern Research Station and its Northern Region counterpart, have recently engaged in proactive joint Hill visits. In general, the role and contribution of R&D is not often part of Region discussions with lawmakers. This likely reflects the lack of close integration between Research Stations and the Regions, and a siloed perspective on their activities.

Framework for Improving Enterprise-Level Communications

Opportunities to address these communication challenges are discussed within a framework for implementing a broader, ongoing process of organizational learning and alignment tailored to the particular circumstances of Forest Service R&D.

Forest Service R&D is a decentralized organization by design. The effectiveness of research organizations depends to a large degree on the professional autonomy to pursue research based on technical expertise. Decentralization is essential to the ability of R&D to be responsive to the highly varied needs across regions and localities, with their different types of forest, terrain, patterns of land ownership and economies.

Unlike a traditional line organization that depends on command and control authority, coordination of a decentralized professional organization depends on indirect mechanisms. There are two essential mechanisms: clear communication of purpose and direction and standard processes. While it may not be appropriate to impose standard performance measures concerning the outputs of professional work, standard processes are essential to ensuring quality and monitoring progress. Acknowledging that differing research projects, programs, and fields vary in timescale and applicability, a scheduled and standardized process should be independent from the estimated time to completion of varying research pursuits and their topics (the content of the work).

Another important means of coordination in a decentralized professional organization is the clear communication of purpose and direction. Research conducted by the Institute for Defense Analyses (IDA) on best practices in management for research and development suggests that decentralization is ineffective "without guidance from top."[83] If decentralization occurs within the context of a clear, coherent strategic direction and plan (a roadmap), it can be a valuable vehicle for managing diffuse innovation. Furthermore, IDA's research showed that a key focus of industry leaders in the commercial sector is to use a clear, coherent strategic process to measure and assess the results and value of their R&D branches.

Recommendations

The Panel recommends that Forest Service R&D addresses its communication challenges by devising and implementing standard processes that enable an organization to monitor and assess its performance against desired future state, as embodied in the vision and goals of strategic plan and continually make adjustments based on identified performance gaps and a changing operating environment.

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[83] Van Atta, Richard H., Michael J. Lippitz, Robert L. Bovey, Rachel D. Dubin, and Samuel L. Blazek. 2011. *Commercial Industry Research & Development Management Best Practices.* Alexandria: Institute for Defense Analyses.

This cyclical process may be understood in terms of four steps that are repeated on a regular basis. These steps are:

1. Gather information on the current state and begin to define the desired future state
2. Develop standard, repeatable processes for gathering information on operations
3. Identify and analyze gaps
4. Translate gap analysis into needed adjustments in organization processes and activities

This cycle is represented graphically in Figure 4 below.
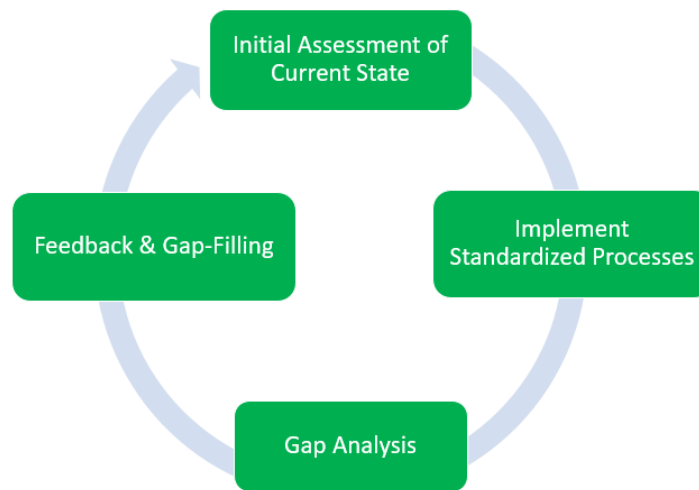
Figure 4: The Iterative Framework

- *Recommendation 4-1*: **Develop and implement a continuous process of learning and alignment**.
    - o *Recommendation 4-1a*: Begin with an assessment of the current state and near term actions to improve communication with stakeholder about the rationale, operations and accomplishments of the enterprise.
    - o *Recommendation 4-1b*: Based on gaps identified during the initial assessment develop standard processes, including evaluation processes to help ensure more robust information and enable continuous improvement.

The remainder of this report provides guidance related to near-term and longer-term efforts to implement a continuous process of learning and alignment as recommended above. In some cases, "Actions for Consideration" called out for particular attention.

Near-term efforts to gather information and communicate current state to stakeholders

The first phase of this process for the leader is defined by an imperative to quickly take steps needed to tell a coherent and compelling story about the organization, its rationale, how it operates, and its contributions the mission. This entails gathering available documentation (e.g., mission statement, budgets, performance reporting) and engaging key internal and external stakeholder groups (e.g., station directors, mission partners and customer groups) to obtain information and to understand the different perspectives needed for an integrated picture of the organization. A model used by NOAA's R&D arm, the Office of Atmospheric Research, to guide the development of its strategic plan, suggests a set of questions a leader can use to inform his data collection efforts and provide a basis for conversations with internal and external stakeholders about the current state and a desired future state.[84]

What is our mission? What types of products will allow us to achieve our aims?
Forest Service R&D has a relatively recent and succinct statement of its mission.

> *"R&D's mission is to conduct innovative and seminal research that provides sound science, innovative technologies and practical applications to improve the health and productivity of our nation's forests and grasslands, inform natural resources policy and land management decisions, and anticipate emerging natural resource issues."*[85]

The Forest and Rangeland Renewable Resources Research Act of 1978[86] is the current legislative authority for Forest Service R&D program. The Act underlines the importance of research to provide sound science to address challenges on public and private lands

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[84] National Oceanic and Atmospheric Administration. 2014. "Ocean and Atmospheric Research Stategic Plan." Washington, DC: United States Department of Commerce, April.

[85] United States Forest Service. December 2017. "Forest Service Research and Development Performance and Accountability Report - Fiscal Year 2016." United States Department of Agriculture, Washington, DC. https://www.fs.fed.us/sites/default/files/fs_media/fs_document/15937_fs_par_2016_508.pdf.

[86] Public Law 95-307; as amended. 16 U.S.C. 1641-1650

and to inform natural resources policy and management decisions. It is written in mission-focused way, providing direction to solve practical problems.[87]

Our research indicates that R&D undertakes an array of activities in support of this mission. In addition to research, R&D is involved in application development, decision support, inventory and monitoring, and applied research and development supporting the commercialization of products and processes.

However, it is not clear how R&D's resources are allocated across these activities. The balance of these activities in R&D's portfolio is an important indicator of efforts to meet customer needs. The allocation of funding across these activities shoud be a focus of data collection efforts.

<u>What are the core capabilities of our organization? What capabilities should we rely on our partners to provide? Are we allocating resources optimally?</u>

One concern raised by stakeholders during the Panel's assessment is the lack of an apparent strategy guiding the allocation of resources across Research Stations and a lack of clarity about how Stations coordinate to avoid unnecessary duplication and tap synergies. This suggests the need to better communicate the work being done by the individual Stations and how it contributes either to distinctive needs of the Regions or to furthering enterprise level priorities.

Toward this end, Washington Office R&D should work with each Station to gather information about the major activities they are undertaking in support of achieving an agreed upon set of enterprise-level mission priorities. This information would form the basis for developing narratives about key ways in which individual Stations contribute to enterprise-level priorities. To support these narratives, information should at the same time be collected on related R&D accomplishments as well as documentation validating their impact. This information could range from the testimony of user groups to quantitative measures where possible.

Also, information should be gathered in support of developing narratives to describe the distinctive needs of the Regions served by the Stations and how their work addresses

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[87] Charles Valentine Riley Memorial Foundation. 2018. "Forest Service Research and Development: Creating the Knowledge Needed to Manage America's Forest Sustainably." Madison. https://rileymemorial.org/files/files/RMF%20FS%20Special%20Report%20Final%205-31-18.pdf.

these needs. Further, these narratives should address cross-Station coordination processes used to avoid unnecessary duplication and to identify synergies.[88]

Funded university research is an important part of a narrative about Station activities and how they relate to both enterprise-level mission priorities and region-specific needs. To help tell this story to improve transparency, information should be gathered on the total amount spent by each Station on university research and to the extent possible how it breaks down by mission priorities. This would begin to describe how university research fits into the mix of work aimed at addressing mission priorities.

In addition to the amounts of funding going to university research, the narrative should include a discussion of the processes and criteria used to decide when to fund research at universities instead of in-house. The aim here is to explain how university research funding decisions fit into a strategy that leverages the distinctive capabilities of universities to achieve mission goals.

These narratives would be useful in building support among funders by providing greater transparency and can be included in documentation such as budget requests. In addition to building support among funders, these narratives can be used to build a greater sense of community among R&D staff across the enterprise around shared mission efforts. These narratives could also be used in communications with other external stakeholders, customers and university partners to similar effect.

<u>How do we do it? In what ways do we conduct activities within our organization?</u>
A key challenge for Forest Service R&D is how to balance responsiveness to customers, who are often focused on near-term needs, with its mission responsibility to do research needed to effectively address current mission needs and to anticipate future mission needs.

To help build support for research, it would be useful to reframe the discussion. Research is often defined as basic or applied. This distinction is reflected in the federal government's definitions.[89] However, this distinction misses a key variable: orientation

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[88] "Narratives" should be understood not only as verbal framing stories, but evidence and visual displays of settled data.

[89] "Research is the "systematic study directed toward a more complete scientific knowledge or understanding of the subject studied." Development is the "systematic use of the knowledge or understanding gained from research, directed toward the production of useful materials, devices, and systems or methods, including design, development,

toward potential use. Research can be understood along two dimensions: (1) its relevance for fundamental understanding; and (2) relevance to application. The two are not mutually exclusive.

This perspective reveals a third, hybrid type of research: "use-inspired" research — *simultaneously* intended to improve our fundamental understanding of the world *and* yield applications that are useful and used.[90] As described in NOAA's R&D plan, "Use-inspired research does not generate basic knowledge under the assumption that it might be applied later, somehow, by someone. Rather, specific uses are understood up front, and those uses are what direct R&D, including the generation of new knowledge."[91]

However, simply reconceptualizing research is not enough. Pertinent real life examples need to be communicated. To this end, Forest Service R&D should work with its Research Station staff and communications staff to collect and describe in accessible ways examples of use-inspired research performed or supported by Forest Service R&D. These examples should be presented within a narrative of furthering mission goals.

In the longer term, the most important step in building support for basic research will be to demonstrate to agency partners how it is tied to mission needs. Region-level needs assessments done in collaboration with internal agency partners offer a potentially powerful way to build support for basic research and R&D investments more generally. (The efforts of individual Research Stations to develop such processes are discussed in Section 3.)

<u>How do we judge our success? What evidence informs programmatic decisions?</u>
In its Performance and Accountability Reports (PARs), R&D reports a variety of performance measures including the total number of peer reviewed publications, the total number of science delivery products and a measure of customer satisfaction (based on survey of internal partners and external customers and stakeholders). These aggregate metrics do not provide useful information on the quality or mission impact of R&D's efforts. To be useful as indicators of performance, these outputs need to be discussed in terms of how they relate to achieving particular mission goals and objectives. Individual science delivery products, such as science syntheses that identify existing science

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and improvement of prototypes and new processes." See: National Science Foundation. 2010. "Globalization of Science and Engineering Research: A Companion to Science and Engineering Indicators 2010." https://wayback.archive-it.org/5902/20150628025647/http://www.nsf.gov/statistics/nsb1003/definitions.htm.
[90] Stokes, Donald E. 1997. *Pasteur's Quadrant: Basic Science and Technological Innovation.* Brookings Institution Press.
[91] 2012. "Research and Development at NOAA: Five-Year Research and Development Plan 2013-2017."

relevant to mission needs can contribute significantly to advancing mission goals. However, science syntheses can vary greatly in scope and importance.

The PARs also provide examples of mission accomplishments related to Forest Service strategic plan goals. However, the descriptions of the work are often very technical and are presented with little context about the mission challenge being addressed and the array of R&D activities being undertaken to that end.

<u>How do we communicate mission accomplishments?[92]</u>
Under this broad question, we focus on congressional engagement. Near-term steps include gathering information on the current patterns of congressional engagement by field personnel, key congressional relationships, and promising practices to be considered in developing standard processes of congressional engagement.

In the course of gathering information and developing a narrative to communicate the rationale, operations and accomplishments of the R&D enterprise, gaps in information will be identified. These gaps will inform the processes development of standard processes in the second phase of the effort.

Longer-term efforts to implement standard processes
Following initial near-term efforts to collect information and to engage stakeholders, the next step is to begin creating or strengthening formal recurring processes of collecting and reporting information, assessing performance, and engaging with stakeholders. The Panel gives particular attention to the following processes.

- Requirements and priority setting processes
- Collection and reporting of information on funding allocation and research activities across the enterprise
- Collection and reporting of accomplishments and other performance information
- Congressional engagement process

A key consideration in developing standard processes for collection, reporting and engagement is making sure to leverage existing processes, guidance and requirements. The Panel emphasizes attention to the requirements and guidance related to the Government Performance Reporting and Modernization Act (GPRAMA) and the Evidence-based Policy Act.

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[92] This question was added to accommodate this study's particular focus on communicating accomplishments.

It is logical and efficient to align and integrate the strategic planning and priority setting processes for R&D with the statutory requirements and agency procedures for updating the Department's (and Forest Service's) GPRAMA-required strategic plan every four years, for conducting annual strategic reviews of performance to inform budget and management decisions, and for developing and reporting performance metrics as required.

Under the Evidence-based Policy Act, agencies are required to develop a "learning agenda." The learning agenda is a plan for developing evidence to support agency planning and decisionmaking. As the research component of the Forest Service, R&D is well-situated to take responsibility for developing a learning agenda for the Forest Service to meet the new statutory requirement and address OMB guidance. Doing so will help ensure that the research priorities and communications activities of R&D are addressing the main gaps in knowledge that must be filled in order to improve the Forest Service's ability to accomplish its mission .

By aligning with mandated, recurring planning and agenda setting processes, R&D can ensure and demonstrate a tighter connection between its priorities and those of its partners and stakeholders, thereby making it easier to communicate its contributions.

Requirements and priority setting processses

A mission research organization should have a small number of outcome-oriented, mission-related goals. [93] These goals provide a focus for the organization's research efforts and provide the parameters of a requirements development process, which in turn underpins priority setting. To be effective in focusing the organization's research efforts, these goals must have buy-in from internal and external stakeholders.

Forest Service R&D has struggled to develop a set of goals or focus areas supported by internal and external stakeholders. Our research indicates that the seven Strategic Program Areas (SPAs) were not well received by some in Congress. The SPAs were subsequently replaced by a set of five research emphasis areas (REAs) developed in response to the urging of OMB and Forest Service leaders for a more streamlined approach. While these five research areas were included in the 2020 Forest Service Budget request, it is not clear how they focus the request or what support there is for this latest grouping of R&D activities. Our research suggests significant effort was invested in

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[93] United States Office of Management and Budget. 2017. *OMB Circular No. A-11: Section 230-2.* Washington, DC: Executive Office of the President.
https://www.whitehouse.gov/sites/whitehouse.gov/files/omb/assets/a11_current_year/a11_2017/s230.pdf.

developing these research areas by Washington Office and research station staff with the collaboration of their NFS counterparts. However, these research areas never received input or approval from NFS leadership in the Regions.

Actions for Consideration:
R&D's four national research priorities and three areas of foundational research are informed by the REAs and could provide the basis for framing requirements and setting priorities. However, R&D's priorities would benefit from additional input from internal Forest Service customers and external stakeholders.

In addition to developing mission-related goals, it is good practice to develop objectives for developing capabilities at the enterprise level that enable achievement of its mission goals. In the case of an R&D organization, these capabilities may be technical or managerial. The NOAA R&D plan provides examples of technical capability-related objectives, including improved data collection and modeling capabilities, and managerial capabilities, including improved stakeholder enagement. This latter objective is in keeping with the importance of effectively engaging internal agency partners and external customers (as discussed in Section 3) to help ensure the that their requirements are effectively integrated into research, research products are delivered in usable ways and products are ultimately used and thereby advance the mission of Forest Service.

Formal and transparent requirements and priority setting processes should be put in place to support the development of budget requests and longer-term strategic planning processes. The following discussion proposes a methodology for such a process, which emphasizes the importance of balancing Region and enterprise-level priorities:

- Research station leaders and their mid-level managers will work in consultation with their NFS partners in the Regions to develop a list of priorities.

  o Section 3 discusses individual Research Station efforts to identify and prioritize needs at the Region level with its internal agency partners and external customers. The successful institutionalization of these efforts and the extension of these processes across Research Stations and Regions promise to significantly strengthen the requirements process by ensuring a more systematic integration of internal Agency partner and external customer needs.

- Region-level requirements will be developed detailing necessary activities and funding needed to make progress. These requirements will be prioritized and submitted to WO R&D.

- WO R&D leadership will choose how to balance Region-level priorities with enterprise-level priorities and develop a narrowed set of priorities for funding.
- This narrowed list of priorities provides the basis for further defining the gap to be filled to make progress on mission goals and capability objectives.
- Measures and targets can then be assigned to each prioritized requirement to enable tracking of progress toward filling the gap.
- Mission goals and capability objectives, priorities, gaps, associated targets and activities for closing the gaps can then be communicated both in budget requests and strategic planning documents to communicate the direction and progress of the enterprise in performing its mission. The NOAA R&D plan provides and example of such communication. For each mission goal/capability-related objective its reports gaps, targets, and activities (activities described by type: i.e., research, development, transition.[94]

Collection and reporting of information on funding allocation and research activities across the enterprise

Useful collection and reporting of research funding allocation will depend on clarifying goals as discussed in the subsection above on 'requirements and priority setting processes'. Once R&D goals are agreed upon, processes can be put in place for Stations to routinely report how much money they are allocating to work related to these goal areas, how much of the money is going to fund university research, how the funded work breaks down type of activity (e.g., research, tool development, decision support).

This reporting would provide R&D with ready access to the data needed to communicate its efforts across mission areas, the relative role of universities in these different mission areas, as well as the mix of activities, which would indicate the balance of longer-term research versus more near term efforts geared toward application.

Collection and reporting of accomplishments and other performance information

Strategic planning is a continuous process that requires constant feedback about how the current strategies are working. Performance measurement provides the organization with information and indicators to determine the effectiveness of the strategies. Strategic planning looks ahead toward desired goals and performance measurement looks back at achievements and informs decision making. The strategic plan defines the performance to be measured, while performance measurement provides the feedback that keeps the strategic plan on target. Performance measurement relies on specified end outcomes—not just activities, but the results of those activities. The strategic plan's goals and objectives focus performance measurement on outcomes and help define appropriate

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[94] 2012. "Research and Development at NOAA: Five-Year Research and Development Plan 2013-2017. 21-27.

performance indicators. The agreed upon goals and objectives for R&D activities will serve as the primary driver for developing performance measures that articulate the outcomes or impacts that the agency will try to achieve.

An effective tool for addressing performance improvement is to adopt a learning agenda for the organization in order to facilitate the identification of opportunities for improved efficiency and effectiveness. It often includes set of questions addressing the critical knowledge gaps that impede informed decision making, identification of activities to address these knowledge gaps and a dedicated approach to sharing the lessons learned. Many learning agenda initiatives link their learning questions and themes to strategic goals and objectives and help to reinforce organizational priorities. These high-level objectives often provide the organizing framework for more specific questions and help to ensure that the learning agendas serve and relate to broader strategic priorities and decision-making needs.[95]

Building these agendas on a strong data-informed foundation enables the organization to better understand why goals are (or aren't) being met, the effectiveness of strategies to meet these goals, and what is needed to improve results.[96] Establishing a learning agenda would help R&D to ensure that funding and allocation decisions are driving mission-oriented outcomes and could help identify new ways to approach process improvement and organizational performance.

<u>Congressional engagement process</u>
It is good practice, to have protocols for congressional engagement to ensure a consistent and coherent communications. This is especially important in the case of a decentralized organization like Forest Service R&D with a history of direct congressional engagement by agency officials in field.

Actions for Consideration:

- Require advance coordination with Forest Service Legislative Affairs and Communications staff prior to any R&D official meeting with a Member of Congress or their staff. The purpose here is to leverage expertise and to ensure that communications are consistent with Forest Service policy and priorities.

[95] Ahearn, Laura, and Matthew Baker. 2017. *Landscape Analysis of Learning Agendas: USAID/Washington and Beyond.* USAID Learning Lab. https://usaidlearninglab.org/library/landscape-analysis-learning-agendas-usaidwashington-and-beyond.

[96] National Academy of Public Administration. 2015. "Learning Agendas Can Produce Performance and Evaluation Evidence." February 15. https://www.napawash.org/standing-panel-blog/learning-agendas-can-produce-performance-and-evaluation-evidence.

- Congressional vistits by field officials should include representatives from R&D and the NFS Region, or at least be coordinated in advance. The purpose here is to ensure that Regions and R&D discuss accomplishments as mission partners. This communicates the message of integration between R&D and Agency partners.
- Conduct advance coordination to identify and agree on mission accomplishments and discussion points, as well as meeting objectives. In general, mission accomplishments should reflect enterprise-level priorities. However, field officials should also be able to discuss mission accomplishments related to the distinctive regional/local needs relevant to the jurisdiction of a particular Member of Congress. The purpose here is to underline a partnership between R&D and its mission partners.
- Following congressional visits, field officials should debrief with Forest Service Legislative and Communications officials to ensure that information and understanding derived from the visits is shared and can inform future visits and Agency planning.

It is important to emphasize that the intent of these protocols is not to control or script discussions with Congress, but instead to help ensure that communications consistently reflect Forest Service priorities and communicate a message of mission partnership, rathter than disparate efforts by siloed agency components.

Appendix A: Panel and Study Team

Michael Dominguez (*Chair***)*,** Former Director, Strategy, Forces and Resources Division; current Adjunct Research Staff Member, Institute for Defense Analyses. Former positions with the U.S. Department of Defense: Principal Deputy Under Secretary of Defense for Personnel and Readiness; Assistant Secretary of the Air Force for Manpower and Reserve Affairs, including service as Acting Secretary of the Air Force; Assistant Director for Space, Information Warfare, and Command and Control, Office of the Chief of Naval Operations. Former Research Project Director, Center for Naval Analyses; General Manager, Tech 2000 Inc.; Associate Director for Programming, Office of the Chief of Naval Operations; Director for Planning and Analytical Support, Office of the Assistant Secretary of Defense for Program Analysis and Evaluation; Executive Assistant to the Assistant Secretary of Defense for Program Analysis and Evaluation; Program Analyst, Office of the Secretary of Defense for Program Analysis and Evaluation; Military service in various assignments with the U.S. Army's Southern European Task Force.

David Birdsell*, Dean, Marxe School of Public and International Affairs, Baruch College, City University of New York; Board Chair, Governance Matters; Board Member, New York Council of Nonprofits; Past President, NASPAA. Former positions with Baruch College: Special Assistant to the President for Institutional Effectiveness; Professor of Public Affairs; Interim Dean, School of Public Affairs; Executive Director of Academic Programs; Associate Professor of Public Affairs; Associate Professor of Speech; Assistant Professor of Speech; Lecturer in Speech & Director of Forensics. Former consultant, Communication, New York City Fire Department; Consultant, Institutional Research and Communication Technology, New York Public Library; Consultant, Communication Strategy, New York Lawyers for the Public Interest; Consultant, Capitol Hill Communication, Congressional Management Foundation; Consultant, Improving Nonprofit Consulting, Bayer Center for Nonprofit Management Foundation; Consultant, Patron and Staff Education for Online Research, Brooklyn Public Library; Consultant, Political Debating, U.S. Information Agency; Lecturer in Speech & Director of Forensics, University of Virginia.

Thomas Kane*, Current Deputy Director, Federal Bureau of Prisons, Department of Justice; Former Acting Director, Federal Bureau of Prisons, Department of Justice;

Assistant Director, Federal Bureau of Prisons. Former positions with Federal Bureau of Prisons: Deputy Assistant Director for Information Technology; Chief of Staff, Executive Office of the Director; Chief, Office of Research and Evaluation; Senior Research Analyst. Former Instructor, New York State Police Academy.

Michael Lipsky*, Former Distinguished Senior Fellow, Demos: A Network for Ideas and Action. Senior Program Director, Demos: A Network for Ideas and Action; Visiting Professor, Public Policy Institute, Georgetown University. Senior Program Officer, Peace and Social Justice Program, The Ford Foundation; Professor, Department of Political Science, Massachusetts Institute of Technology; Assistant Professor, Department of Political Science, University of Wisconsin at Madison. Author of: Street Level Bureaucracy: Dilemmas of the Individual in Public Services (Russell Sage Foundation,1980, 2010 [expanded edition]). Co-author of: Nonprofits for Hire: The Welfare State in the Age of Contracting (with S.R. Smith) (Harvard University Press,1993).

Kay Goss*, President and CEO, World Disaster Management, LLC, since 2012; Senior Associate for the Learning Team for Emergency Management and Homeland Security, 2011-2012; Senior Principal and Senior Advisor for Emergency Management and Continuity Programs, SRA International, 2007-2011; Senior Advisor for Emergency Management, Homeland Security, and Business Security, EDS, 2001-2007; Associate FEMA Director in charge of National Preparedness, Training, Higher Education, and Exercises, (Presidential Appointee, Confirmed Unanimously by US Senate, 1993-2001; Senior Assistant to the Governor for Intergovernmental Relations, Little Rock, AR, 1982-1993; Chief Deputy State Auditor, 1981-1982; Research Director, Arkansas State Constitutional Convention, State Capitol, 1979-1980; Project Director, Association of Arkansas Counties, 1979-1980; Project Director, Educational Finance Study Commission, Arkansas Legislature, 1977-1979.

Steve Redburn*, Professorial Lecturer in Public Policy and Public Administration, The Trachtenberg School of Public Policy and Public Administration, The George Washington University. Former Study Director, National Academy of Sciences; H. John Heinz III College of Public Policy & Management, Carnegie Mellon University Australia; Project Director and Consultant, National Academy of Public Administration; Chief, Housing Branch, U.S. Office of Management and Budget; Economist, Special Studies, U.S. Office of Management and Budget; Program Analyst, Office of Policy Development and Research, U.S. Department of Housing and Urban Development; Director, Center for Urban Studies, Youngstown State University.

Study Team

Brenna Isman, *Director of Studies* – Ms. Isman provides oversight on all the Academy's studies. including the Academy's assessments of Congressional agencies' technology policy capabilities, the Federal Aviation Administration (FAA) drone regulation program, the National Park Service (NPS) Design and Construction program, and the U.S. Secret Service's organizational climate. She has also directed statutorily required assessment of the National Aeronautics and Space Administration (NASA)'s use of its Advisory Council and the Academy's Congressionally directed study of regulatory affordability for the Environmental Protection Agency (EPA). She holds an MBA from American University and a Bachelor of Science in Human Resource Management from the University of Delaware.

Jonathan Tucker, *Project Director*— Dr. Tucker's areas of expertise include: strategic planning/foresight, organizational design, change management, and S&T/innovation policy. His public management consulting experience includes projects with twenty federal agencies. Recent projects include: assessment of research coordination function at the U.S. Department of Transportation; developing a strategic plan for the Office of Urban Indian Health Programs (U.S. Indian Health Service); developing options for the establishment of a new Under Secretary at USDA focused on international trade; developing a white paper for the Project Management Institute on institutionalizing project and program management in the federal government; assessing Census transformation initiatives; developing a long-term strategic plan for operational transformation at the Social Security Administration. In addition to his consulting activities, Jon contributes to the work of the Academy's Strategic Foresight Panel (part of the broader Academy Transition 2016 initiative). Dr. Tucker also has experience assessing science and technology policies and programs, with a focus on supporting innovation. He has worked for organizations including Battelle; the National Research Council; the National Institute of Standards and Technology; and the New York State Department of Economic Development. He holds a Ph.D. in Public Policy (with a concentration in Science and Technology Policy) from George Mason University, an M.S. in Science and Technology Studies from Rensselaer Polytechnic Institute, and a B.A. from New College of Florida.

Chloe Yang, *Research Analyst* – Since joining the Academy in 2009, Ms. Yang has worked

on projects with a range of federal agencies. These include the Office of Management and Budget (OMB) Collaborative Forum Coordination and Facilitation project, the Government Printing Office (GPO) Organizational Review, the Amtrak Office of Inspector General (OIG) Organizational Assessment, the U.S. Coast Guard Financial Management and Procurement Review, and the Government Accountability Office (GAO) Comptroller General Position Structure and Compensation Review. Before joining the Academy, Ms. Yang was the research intern at the Foundation of Environmental Security and Sustainability. She also worked as an intern at the Woodrow Wilson Center for Scholars and a research assistant at George Mason University (GMU). Ms. Yang graduated from GMU with a Masters of Public Administration. She also holds a bachelor's degree in Financial Management from the Renmin University of China.

Kate Connor, *Research Analyst* – Ms. Connor joined the Academy in 2018 and has served on several Academy studies, including work for the Agricultural Research Service and the Defense Nuclear Facilities Safety Board. Prior to joining the Academy, she also served as a Public Policy and Government Relations Intern with the American Association of University Women and as an intern on the U.S. Senate Committee on the Budget. Ms. Connor taught high school for several years in Guilford County, North Carolina and she recently graduated from Georgetown University with a Master's in Public Policy. Ms. Connor also holds a Bachelor of Arts in History and Political Science and a Master's in Teaching from the University of North Carolina at Chapel Hill.

Kyle Romano, *Research Associate* – Mr. Romano has provided research and analytical support on Academy studies including the US Bureau of Prisons Health Information Management System and the Federal Aviation Administration Drone Regulation Program. Mr. Romano recently graduated from the School of Public and Environmental Affairs at Indiana University where he earned a Master of Public Affairs. He attended the University of Central Florida for his undergraduate studies where he earned a BA in Political Science and a BS in Legal Studies. His previous research initiatives include work with the Sanibel Re-Analysis Team and the Hebrew Immigrant Aid Society.

Appendix B: Participating Individuals and Organizations

<u>**U.S. Forest Service Officials**</u>

U.S. Forest Service Headquarters

    Hall-Rivera, Jaelith – Associate Deputy Chief, State and Private Forestry

    Legarza, Shawna – Director, Fire and Aviation Management

    O'Connor, Katie – Director, Office of Communication

    Rapp, John – Budget Director

U.S. Forest Service Headquarters--R&D Washington Office

    Bramwell, Lincoln – Chief Historian

    Bush-Butler, Deborah – Chief of Staff

    Friend, Alex – Deputy Chief for R&D

    Hancock, Tracy – Director, Knowledge Management & Communications, Washington Office

    Heath, Linda – Director, Inventory, Monitoring & Assessment Research, Washington Office

    Lucero, Carl - Director, Landscape Restoration & Ecosystem Services Research, Washington Office

    Patel-Weynand, Toral – Director, Sustainable Forest Management Research, Washington Office

    Sanchez, Felipe – Budget Coordinator

U.S. Forest Service Research Station Directors and Staff

    Anderson, Paul – Station Director, Pacific Northwest Research Station

    Archuleta, Ron – Assistant Station Director, Operations and Strategic Planning, Rocky Mountain Research Station

    Doudrick, Robert – Station Director, Southern Research Station

Ferguson, Tony – Director, Northern Research Station and Forest Products Laboratory

Hayes, Jennifer – Assistant Station Director for Science Applications and Communications, Rocky Mountain Research Station

Jackson, Gerry – Assistant Director, Southern Research Station

Phipps, John – Station Director, Rocky Mountain Research Station

Schwalbach, Monica – Assistant Director, Southern Research Station

Warziniack, Travis – Research Economist, Rocky Mountain Research Station

U.S. Forest Service National Forest System

Arney, Ken – Regional Forester, Region 8

Atkinson, Kathleen – Regional Forester, Region 9

Bierman, Sylvia – Deputy Director, Renewable Resources, Region 2

Ferebee, Brian – Regional Forester, Region 2

Joyner, Cal – Regional Forester, Region 3

Moore, Randy – Regional Forester, Region 5

External Stakeholders

Alavalapati, Janaki – President-Elect, National Association of University Forest Resource Programs

Angle, Scott – Director, National Institute of Food and Agriculture

Barnwell, John – Director, Society of American Foresters

Brink, Steve – Vice President, Public Resources, California Forestry Association

Jacobs-Young, Chavonda – Agricultural Research Service Administrator and Acting Chief Scientist

Karels, Jim – Florida State Forester, National Association of State Foresters

Lester, Mike – Colorado State Forester, National Association of State Foresters

Martin, Christopher – Connecticut State Forester and NASF Forest Science & Health Committee Chair, National Association of State Foresters

Martin, Tom – President & CEO, American Forest Foundation

Owen, Carlton – President & CEO, U.S. Endowment for Forestry and Communities

Topik, Christopher – Director, Restoring America's Forest Program, The Nature Conservancy

Appropriations Committee and Staff

Hunt, Ryan - Senate Committee on Appropriations, Subcommittee on Interior, Environment, and Related Agencies

Lesofski, Emy – Senate Committee on Appropriations, Subcommittee on Interior, Environment, and Related Agencies

U.S. Office of Management and Budget

Hazelgren, Mark – Program Examiner, Natural Resources Division

Saunders, Ruth – Branch Chief

External Experts

Cleaves, David – Former Deputy Chief of Forest Service R&D

Doremus, Paul – Acting Director, Office of International Affairs and Seafood Inspection, National Marine Fisheries Service, National Oceanic and Atmospheric Administration; and Deputy Assistant Administrator for Operations, National Marine Fisheries Service, National Oceanic and Atmospheric Administration

Farooque, Mahmud – Associate Director, Consortium for Science, Policy & Outcomes

Guldin, Richard – Senior Research Fellow, Society of American Foresters

McLean, Craig – Acting Chief Scientist; Assistant Administrator, Oceanic and Atmospheric Research, National Oceanic and Atmospheric Administration

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