USDA-Forest Service RESEARCH WORK UNIT DESCRIPTION Ref: FSM 4070	1. Number FS-SRS-4854	2. Station Southern Research Station
	3. Unit Locations Research Triangle Park and Asheville, NC	

4. Research Work Unit Title
SRS-4854: Eastern Forest Environmental Threat Assessment Center

5. Project Leader (Name and Address)

Ge Sun, USDA Forest Service, 3041 East Cornwallis Road, Research Triangle Park, NC 27709

6. Area of Research Applicability	7. Estimated Duration
Landscape, regional, national, and global threats to forest health	5 years

8. Mission

The mission of the Eastern Forest Environmental Threat Assessment Center is to generate knowledge and tools needed to anticipate and respond to environmental threats.

9. Justification and Problem Selection Summary

The mission of the Eastern Forest Environmental Threat Assessment Center ("Eastern Threat Center" or "Center") is to generate knowledge and tools needed to anticipate and respond to environmental threats. The most serious threats to forests involve complex factors interacting across multiple spatial and temporal scales. The Center's challenge is to maintain a comprehensive and integrated research program to tackle these complex issues, while delivering knowledge to forest landowners, managers, decision-makers, scientists, and other interested audiences in a timely, useful, and user-friendly manner. The Eastern Threat Center's mission and governance were established in its original 2005 charter.

The Center addresses problems related to the science of monitoring, assessment, prediction, and communication across four primary classes of environmental threats. These four classes include threats from biotic agents and processes, weather and climate change, wildland fire, and changes in land use or land cover. Biotic threats include both native and non-native invasive insects, pathogens, and plants. Weather and climate change include the direct effects of extreme events such as hurricanes, ice storms, tornadoes, floods, and droughts, and more broadly, the complex interactions of climate change and variability throughout ecosystems and landscapes across scales. Wildland fire is a major concern, presenting complex management tradeoffs related to people, ecosystems, communities, and landscapes. Land use/land cover change results from disturbances and human-related development, which creates intricate forest patterns within a mosaic of other landscape elements.

Signature	Title	Date
Prepared By: /s/ Dana Roth DANA ROTH Digitally signed by DANA ROTH Date: 2023.02.10 11:29:32 -05'00'	Assistant Station Director for Research	2/9/2023
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9. JUSTIFICATION AND PROBLEM SELECTION

SRS-4854 – Eastern Forest Environmental Threat Assessment Center
Research Triangle Park and Asheville, NC
Project Leader: Ge Sun

The mission of the Eastern Forest Environmental Threat Assessment Center ("Eastern Threat Center" or "Center") is to generate knowledge, acquire insight, and develop tools needed to anticipate, evaluate, and respond to environmental changes that affect sustainable forest management. The most serious threats to forests and to the benefits they provide typically involve complex factors interacting across multiple spatial and temporal scales. The Center's challenge is to maintain a comprehensive and integrated research program to tackle these complex issues, while delivering knowledge to landowners, managers, decision makers, scientists, and other interested audiences in a timely, useful, and user-friendly manner. The Center engages partners throughout the research process with expectations that co-developed science is more likely to be relevant and used. The Eastern Threat Center's mission was originally established in its 2005 charter, which was signed by the deputy chiefs for the National Forest System, Research and Development, and State and Private Forestry.

The research of the Eastern Threat Center aligns with numerous USDA and Forest Service strategies and plans, particularly the USDA Strategic Plan, the Forest Service Strategic Plan, the Wildfire Crisis Strategy, the USFS Climate Adaptation Strategy and the Shared Stewardship Strategy. The fundamental goals and strategic approaches articulated in these national frameworks are reflected by research-relevant problem statements and approaches to problem solutions found in this Research Working Unit Description. For example, the four outcome-oriented goals of the US Forest Service's most recent Strategic Plan include 1) sustain our nation's forests and grasslands, 2) deliver benefits to the public, 3) apply knowledge globally, and 4) excel as a high performing agency. The Eastern Threat Center's program of research intersects each of these strategic goals as improving applied science can help sustain the natural resources that maintain benefits for the public. Efficient and effective application of science-based knowledge is necessary for the US Forest Service to continue to function as a high performing agency.

The Eastern Threat Center fosters creativity and innovation while incubating new ideas and approaches. Its scientists engage in projects at the forefront of technology development, application, and transfer in forest threat detection and assessment. Researchers develop novel indicators of landscape change and provide land managers and policy makers with new insights and tools needed for monitoring and strategic planning. Center scientists and partners collaborate to address long-standing and emerging issues related to forest ecosystems, including water, biodiversity, fiber, and carbon sequestration—all within the context of changing disturbance regimes, a changing climate, and shifting demands for ecosystem services with socioeconomic constraints.

The Center addresses problems related to the science of monitoring, assessment, and communication across four primary classes of environmental threats. These four classes include threats from biotic agents and processes, weather and climate change, wildland fire, and changes in land use or land cover. Biotic threats include both native and non-native invasive insects, pathogens, and plants. Weather and climate change include the more direct effects of extreme events such as hurricanes, ice storms, tornadoes, and droughts, and more broadly, the complex interactions of climate change and variability throughout ecosystems and landscapes. Wildland fire is a growing concern, presenting complex management tradeoffs related to people, ecosystems, communities, and landscapes. Land use/land cover change results from human-related development and urbanization, which creates

intricate forest patterns within a mosaic of other landscape elements.

Three characteristics distinguish much of the work performed by the Center: 1) the efforts are regional to global in scope, 2) the work is integrative, and 3) the emphasis is synthetic. The Center strives to address critical broad-scale management needs across all four threat areas, and its research focuses on resource managers' needs for monitoring their occurrence, interpreting their extent and implications, predicting their likely impact, evaluating the likely consequences of management responses, and sharing results, technology, and resources with affected organizations and individuals. At times, Center scientists also perform foundational field, laboratory, statistical, and theoretical research that is essential to the larger efforts at the regional and national scales.

Because of its cross-disciplinary, tri-deputy administrative design and broad responsibilities, the Center is charged with actively bridging research and management. Guided by interactions with external state and federal agencies, university partners, tribal entities, NGOs, the USDA Regional Climate Hubs, and other Forest Service units and entities, Center researchers aspire to distill complex, multi-faceted problems toward solutions that are recognized as intuitive and useful to the managers who implement them. This capacity is key for responding to aspects of the various departmental and agency strategic plans with the most relevant science, at scale.

One challenge with bridging research and management is that management information needs are often mismatched with research efforts. The Center operates across a spectrum of spatial and temporal scales, ranging from addressing impacts from disturbances in near-real-time to quantifying ecosystem recovery or long-term trends for landscapes and regions that may lead to more fundamental ecosystem conversions. In turn, a crucial aspect of the Center's work is the translation of results at one scale to other relevant scales. For instance, Center scientists use broad-scale approaches to inform local problems, scaling up location-specific findings to generate more widely applicable principles.

The Eastern Threat Center works closely with its sister center, the Western Wildland Environmental Threat Assessment Center in Portland, Oregon, to coordinate national approaches to common problems. While the Centers' conduct national-scale research, the Eastern Threat Center's work includes a particularly strong emphasis on state and private lands. The Centers have a shared history and mission, both arising from Forest Service and Congressional action following the Healthy Forest Restoration Act of 2003.

The work of the Eastern Threat Center is organized into three problem areas focused on monitoring, assessment and information exchange:

PROBLEM AREA 1: Improved *monitoring* methods are needed to facilitate detection of forest threats, identify meaningful change, and interpret landscape patterns and processes associated with those threats.

Problem 1a: MONITORING METHODS AND TOOLS. Monitoring to detect forest threats, characterize their extent and severity, and track their effects on forest conditions through time requires new methods and tools for processing, measuring, and interpreting observational data, as well as new techniques to combine multiple data sources in novel ways.

Problem 1b: INDICATOR DEVELOPMENT. To enable reporting about forest threats at regional, national, or global scales, monitoring data must be summarized using indicators. Foundational

research may be necessary to determine which indicators best satisfy information needs, develop robust indicators from observed data, and define baseline conditions that provide suitable frames of reference.

Why is Problem 1 important?

Our ability to recognize and track a wide variety of threats is essential for effective forest management. Consistent with departmental and agency strategic plans, these threats include climate change and extreme weather, wildland fire, native and non-native insects and diseases, invasive plants, and land use/cover change. To address them, Center research includes: 1) providing up-to-date information regarding specific threats to places, people, ecosystem services, and natural resources of concern, particularly with measures that are useful at scale; and 2) developing specialized tools and techniques to improve forest and landscape monitoring more generally.

Monitoring can be surprisingly difficult, particularly when information is required by diverse end users and when it must be compiled across jurisdictions. Sometimes research has yet to resolve suitable measures or indicators that adequately capture a threat or its impacts. Indicators are metrics or measures that can be interpreted consistently across different times, ecosystems, regions, and jurisdictions. Relevant data are rarely collected or available uniformly, and perhaps worse, measures are often not uniformly meaningful across scales or geographies because of differences in forest characteristics. Sometimes monitoring can be improved with more precise measurements, although this can present challenges for inventory design or monitoring technologies. In other cases, efficiency demands that coarse metrics be developed that provide broad hierarchical and contextual insight. Regional to global scale characterizations of forest conditions and threats require standardized indicators that are often not yet developed. In response to these varied needs, Center research includes the development of spatial measures and indicators that target specific scales and others that function across scales. Center researchers also work to improve monitoring across a range of temporal scales including near-real-time, annual, and multi-year periods. Development of consistent long-term monitoring datasets is a necessary precursor for tracking long-term change and for developing predictive models.

Center researchers utilize a variety of regularly collected data streams, including from satellite imagery, Forest Inventory and Analysis (FIA) data, weather and hydrological station observations, and other specialized datasets. Research involves developing innovative ways to exploit existing data, such as deriving functional metrics for detecting potential threats, assessing forest conditions, and tracking change across scales. These new monitoring methods, metrics, and strategies must be evaluated for their sensitivity and effectiveness for their intended purposes. In some instances, innovative foundational research is necessary to overcome monitoring challenges.

The Center's monitoring research includes direct measures of forest conditions, such as forest canopy cover, the disturbance processes or stressors that cause change, and the secondary effects of forest changes, such as impacts to streamflow or other ecosystem services. Integrating these eclectic measures is important for building and calibrating models and for understanding how future changes can affect the values that we care about and that are emphasized in agency and partner priorities.

Some forest threats are particularly difficult to monitor at both high resolution and at broad scales. For example, many non-native invasive insects and pathogens are narrowly host-specific, and the uncertain distribution of hosts makes it challenging to contextualize impacts at scale. Other impacts are slow to manifest, and this requires development of monitoring techniques that meaningfully capture long-term

change.

Monitoring can be exploratory, designed to determine status or to summarize conditions, or it can be confirmatory, designed to verify or test results of prior management actions. In either case, monitoring is more likely to be utilized and maintained long-term if it is efficient and cost-effective.

Benefits of problem solution

Early recognition of trends in forest condition help planners and decisionmakers prioritize areas for intervention. Timeliness of intervention is often critical for keeping maintenance or remediation costs low and for sustaining forest resources or services in a desired state.

At local to continental scales, forest managers, planners and decisionmakers depend on forest monitoring to characterize forest threats and to document the effectiveness of management activities. Analysts tasked with such assessments benefit from indicators research.

Likelihood of problem solution

The unit has made great progress in developing new approaches to forest monitoring and indicator development across scales. As new technologies emerge, the unit's research is highly likely to further refine techniques and indicators to improve understanding. This includes advances in use of Forest Inventory and Analysis data, remote sensing products and advanced integration of diverse datasets. Mechanisms should be in place to evaluate and, if necessary, modify monitoring efforts based on feedback from resource managers, policymakers, and stakeholders.

Resource needs and growth opportunities

Continued access to large computing facilities and cloud resources is critical for broad-scale monitoring research and development. Such technological developments provide unprecedented and efficient access to information that can lead to cutting edge indicators and new and improved monitoring insights.

PROBLEM AREA 2: Innovative approaches to *assessment* and *prediction* are needed to improve understanding of the realities and implications of ecosystem change.

Problem 2a: FUNDAMENTAL UNDERSTANDING. Foundational knowledge of the key patterns and processes that influence ecosystem change is sometimes lacking. Process based research across scales can improve or validate ecosystem models. This can involve or integrate fieldwork and/or larger scale datasets.

Problem 2b: STRESSORS AND RESPONSES. Ecosystem values and services can be affected by uncharacteristic or novel changes in weather and climate, land use or land cover change, wildfire, and invasive species. As implications and impacts of these stressors are rarely certain, applied theory and innovative approaches to modeling can anticipate problems before or as they evolve. This problem includes the need for syntheses of bodies of existing knowledge to make knowledge more accessible.

Problem 2c: QUANTITATIVE RISK ASSESSMENT. The quality of management decisions that involve high uncertainty can be improved through a variety of quantitative risk assessment approaches. As decisions often impact multiple values at once, a key need for applied assessments is to address proposed solutions in terms of their likely and conditional tradeoffs.

Problem 2d: MODELING AND PREDICTION. Predicting change in ecosystems and services under a variety of projections or scenarios can lead to earlier intervention, improved management, mitigation, or adaptation, but accurate predictive tools and forecasts are often lacking. Improved prediction across a range of environmental or management scenarios can make forest management decisions more proactive than reactive.

Why is Problem 2 important?

To achieve long-term societal goals of sustaining forests, more information is needed than the knowledge gained from monitoring. Although it is a necessary first step, monitoring – including when it involves the application of indicators – is insufficient for understanding the implications of existing and emerging threats and providing information support for strategic management responses. Assessment involves developing synthetic frameworks that analyze, interpret, and present information in ways that relate and respond to the pressing needs of policy makers, planners, and managers, as articulated in departmental and agency strategic plans. The end users of knowledge may struggle to ascribe meaning and value to science that lacks context. The Center conducts foundational research when such knowledge is likely to improve the quality of future assessments and predictions. The Center also conducts synthetic assessments to help forest practitioners better interpret the significance and relevance of published science.

Assessments provide a set of approaches to digest and structure applied knowledge, though these vary greatly in their formality, rigor, and purpose. Some are largely narrative descriptions of the status and problems experienced by forests, while others attempt to rigorously quantify risks and tradeoffs to multiple values of concern. The most advanced assessments provide policy or management options for problem solution and communicate the uncertainties and assumptions from imperfect models or datasets. Guided by a clear vision or framework for knowledge acquisition and application, assessments connect foundational science, monitoring, and implementation. They also help identify and prioritize information most relevant to the decisions surrounding a particular set of issues. Within such a framework, scientific models can synthesize or organize related information in ways that make it more accessible and interpretable.

Quantitative risk assessment provides a powerful approach to addressing uncertainty in forest management. This process involves the formal consideration of values so that they are unambiguously expressed as measures, followed by a formal evaluation of the factors that, in a causal sense, put those measures at risk. This framework then allows an exploration of consequences and how they are likely to vary across scenarios or management alternatives. The quantitative aspect is founded on the statistical concepts of probability and likelihood, and includes flexible and readily updatable tools, such as Bayesian information networks. Part of the flexibility of these networks stems from their ability to integrate the effects of multiple independent drivers to address multiple outcomes as part of a comprehensive comparative risk assessment process. Likewise, modern optimization techniques, including spatial optimization models and machine learning, can incorporate aspects such as practical constraints on managers as well as competing objectives and tradeoffs when determining optimal solutions across varied management scenarios.

Assessment also involves formal approaches to predicting variability, over time and across space, of threats, ecological conditions, and interactions thereof—including into the future—to provide context for decision-making and planning. For example, predicting likely future ecological consequences of climate change involves a variety of modeling approaches that quantify observed patterns as a basis for predicting outcomes under modeled future climate scenarios.

Assessments and predictions become exceedingly important when they target problems that impact multiple aspects of highly complex systems. Many ecosystems are inherently dynamic across spatial and temporal scales or levels of organization, experiencing novel changes in invasive species, land use/land cover, wildland fire, extremes in weather and climate, or other uncharacteristic disturbances. As demand for a range of ecosystem services grows, assessments through time often involve characterizing potentially controversial and challenging tradeoffs. Such tradeoffs can be most acute when the future is most uncertain.

Benefits of problem solution

As forest ecosystems and societal changes are complex, science that is integrative, contextual, and prognostic provides forest planners, decisionmakers, stakeholders, and the public at large with credible information.

Accurate insights from assessment and prediction are critical for informed decisionmaking, and this research can better ensure long-term forest sustainability under dynamic future conditions.

Likelihood of problem solution

While the success of formal assessment efforts is project specific, science that falls under this problem is often additive and cumulative. Forest planners and managers are eager to have better assessment and prediction capabilities that rely on the best available science and success may be best measured by incremental or project-specific implementation.

Resource needs and growth opportunities

Broad scale assessment and prediction research typically requires specialized expertise, sophisticated modeling software, and access to cloud computing resources. This requires long-term commitments to sustain personnel and high-speed computing resources. Additional staffing will improve the unit's modeling and assessment capabilities. Collaborations across units and with external entities can provide opportunities for better integrating social and environmental aspects that are important for modeling.

PROBLEM AREA 3: Active information exchange is essential to ensuring that science is used in management, and equally important in fostering relevant and useful science.

Problem 3a: FOUNDATION BUILDING. Opportunities to create and strengthen effective and efficient information exchange are enhanced by understanding and gauging stakeholder needs, and by using best practices for extension. The Center strives to increase its long-term effectiveness by formulating highly relevant research questions through active engagement and collaboration across organizational or administrative scales, from landscape to global.

Problem 3b: ENGAGEMENT WITH PROVEN AND NEW TECHNOLOGIES. A wide spectrum of products, tools, and services are needed to engage diverse, multi- faceted audiences; to increase their understanding of forest threats; and to encourage long-term adoption through collaborative development. The desired goal is an interactive, bi-directional information exchange to achieve coproduction in resource development. Everyone at the Center has an important role to play in achieving such engagement.

Problem 3c: REPORTING. Scientists, managers, decisionmakers and policymakers tasked with characterizing and stewarding forest ecosystems require timely reports that summarize the status of current and emerging situations within and surrounding those ecosystems. Reporting is most likely to be well-received and used effectively when crafted to relay rigorous science in credible, digestible, and accessible communication formats.

Why is Problem 3 important?

As the amount and availability of scientific information grows, new challenges and opportunities arise for sharing science and information regarding forest threats and landscape change. The Center actively engages in sharing information, tools, and resources that partners, customers, and other users can readily use and apply to sustain natural resources, especially in the face of new, evolving, and interacting threats to forests. The Center also strives to engage partners throughout the full cycle of science production under the assumption that co-developed science is more likely to be relevant and used.

Responding to emerging forest threats and sustaining natural resources across changing landscapes require active information exchange between and among customers and scientists, including resource managers and planners, policy- and decision-makers, management and extension specialists, researchers, and stakeholders. Such collaborative research development and exchange is a key means for research to align effectively with departmental and agency strategic plans that emphasize forest and community threats involving diverse stakeholders and jurisdictions. This critically important exchange of information is complicated by complex networks of individuals with widely varying roles, responsibilities, interests, and understanding of natural resource values and threats to sustainability. The Center is uniquely positioned to interconnect these networks, to create advanced tools and products that streamline information exchange, and to establish methods to develop tools and products that meet diverse, multi-dimensional customer needs.

Fundamental to successful information exchange is identifying the scientific information most relevant to policy- and decision-makers, understanding the role of management and extension specialists to facilitate this critical information exchange, and recognizing societal values linked to natural resources. The Center works with customers to understand their priorities and needs, and to ensure that tools and products are designed and implemented in useful and meaningful ways. This understanding is gained through both direct and indirect methods—directly through consultations with representative customers, and indirectly through review of existing customer products. Both methods inform scalable solutions that include not only relevant information, but also mechanisms, techniques, and capacities to deploy successful products that meet customer priorities and needs.

The Center provides critical scientific leadership for regional, national, and global forest reporting efforts—one key aspect of effective science communication. Most of these efforts are mandated to

follow a regular reporting cycle, typically annual or every 5 to 10 years. Center researchers produce summary products and documentation of targeted disturbances and other changes, providing yearly and multi-year context. This research provides the insight needed to distinguish normal forest dynamics from trends or type conversions of particular concern. Attention to the need for integration and synthesis, and the explicit consideration of multiple spatial and temporal scales in monitoring and assessment, puts the Center in a unique position to provide synoptic evaluations. In addition, Center research includes topical syntheses that help summarize and contextualize existing science at broad scales. These various efforts benefit from an intersection of scientific rigor and commitment to effective information exchange, which the Center is positioned to provide.

Benefits of problem solution

Access to the most relevant science is critical for forest policy- and decisionmakers. Federal, state, and private forest owners, and the public at large, can also benefit from tools and technology that are better tailored to their various needs.

Active exchange ensures that the most pressing science is undertaken by researchers, and its results are elevated through appropriate means of communication. This increases the likelihood of adoption or utilization.

Likelihood of problem solution

Effective information exchange achieves success in two directions: forest managers or planners help to focus research and researchers respond with relevant science. The unit has many examples of successful interactions that have led to refined tools, technology and information, and this trend is likely to be maintained contingent on continued dedicated staffing.

Resource needs and growth opportunities

Increased support for developing online delivery mechanisms through new staffing and/or targeted contracting efforts will improve science exchange.

10. APPROACH TO PROBLEM SOLUTION

<u>PROBLEM AREA 1</u>: Improved monitoring methods are needed to facilitate detection of forest threats, identify meaningful change, and interpret landscape patterns and processes associated with those threats.

Planned research and accomplishments

Accomplishments will be provided on a continual basis throughout the life of the Working Unit Description.

Problem 1a (monitoring methods and tools)

- Systematic landscape and national monitoring of the occurrence of biotic and abiotic stressors, including the introduction or initiation of new stressors and long-term trends in their occurrence
- Testing and refinement of monitoring techniques and methodologies applied to forest threats, including methods for distinguishing causal agents and processes from one another or for characterizing their interactions

- Syntheses related to forest monitoring science and technology
- Development of varied data sets into integrated monitoring systems

Problem 1b (indicator development)

- Identifying indicators that enable systematic landscape and national monitoring of forest conditions and threats
- Developing value-added monitoring indicators that cross spatial resolutions and that can be measured consistently across geographic regions and jurisdictions
- Developing broadly applicable indicators for monitoring long-term response to disturbance, such as multi-year trajectories in decline or the rate of recovery

Anticipated outcomes

- Local, regional, and national stakeholders will gain understanding of the pattern and impacts of biotic and abiotic stressors acting both individually and collectively.
- Forest stakeholders will gain more effective, rapid, and efficient monitoring capability from value-added forest threat and response indicators.
- Forest stakeholders will be better able to systematically detect, track and interpret threats through more effective use of extensive data sets, including the ability to recognize change that may otherwise have been overlooked.
- Landscape and regional planners will benefit from monitoring that provides systematic insights at coarse scales across jurisdictions.
- Vulnerability indices and forest health indicators will be better developed for diverse communities.

PROBLEM AREA 2: Innovative approaches to assessment and prediction are needed to improve understanding of the realities and implications of ecosystem change.

Planned research and accomplishments

Accomplishments will be provided on a continual basis throughout the life of the Working Unit Description.

Problem 2a (*fundamental understanding*)

- Discovery of basic knowledge about how ecosystems work with implications for how ecosystems are managed
- Development or refinement of new theories that may eventually be incorporated into applied science products
- Validation of existing models using empirical information obtained through field or remotely sensed observations

Problem 2b (stressors and responses)

- Focused analyses on the effects of wildfire, drought, insects and diseases, development, land cover/land use change, invasive species, weather and climate change on specific values or ecosystem services such as water, forest species diversity, forest cover and configuration, carbon sequestration, and resilience
- Syntheses of existing knowledge of forest stressors and their effects for broader appreciation of the "state-of-the science"

Problem 2c (*quantitative risk assessment*)

- Analysis of the risks associated with different decisions for prioritizing management efforts, such as treatments or restoration options
- Elucidation of the tradeoffs associated with management options
- Determination of the optimal management choices based on conditions

Problem 2d (modeling and prediction)
- Spatial or temporal prediction of multiple stressors and their impacts for management decision making
- Predictions of how specific management options are likely to have desired effects
- Projections of the effects of change in stressors or disturbance regimes using empirical trends and models

Anticipated outcomes

- Scientists and managers will improve their understanding of ecosystem patterns and processes with basic science that enables broad-scale assessment and prediction.
- Agencies and other entities charged with conducting forest assessments will benefit from having access to science-based exemplars, improved datasets, relevant models, and insights.
- Forest decision makers faced with difficult tradeoffs can make more inclusive, transparent, and rigorous decisions using emerging approaches to quantitative risk assessments.
- With more accurate predictive models in hand, decision makers will become more proactive than reactive when managing issues that affect long-term forest resilience.
- Short- and long-term disturbance impacts that affect diverse communities will be better understood.

PROBLEM AREA 3: **Active information exchange is essential to ensuring that science is used in management, and equally important in fostering relevant and useful science.**

Planned Research and Accomplishments

Accomplishments will be provided on a continual basis throughout the life of the Working Unit Description.

Problem 3a (foundation building)
- Increase the effectiveness of the Center's approaches to information exchange

Problem 3b (engagement with proven and new technologies)
- Refinement of applied web-based forest and disturbance monitoring tools that enable highly engaged forest managers to monitor, assess or predict threats to the health of individual forests or landscapes
- Targeted efforts to engage forest managers through online communications or with technical consultations including underserved communities
- Broad engagement of individuals, agencies, and organizations through webinars and in-person meetings to highlight new products or information
- Engagement of narrowly targeted individuals, agencies and organizations through hands-on workshops that highlight new products or approaches

Problem 3c (reporting)
- Regular timely reporting that summarizes the status and trends of forest indicators and key stressors using a variety of datasets such as forest inventories and remote sensing

Anticipated Outcomes

- Increasingly effective engagement with key stakeholders including underserved communities.
- More refined models for information exchange between scientists and managers will help ensure that science is highly relevant and used to make better decisions.
- Forest managers will be more likely to use relevant science when it is tailored to their specific needs and presented in accessible formats.
- A broad distribution of forest information will ensure that underserved groups and the public overall are more aware of the importance of forests and growing threats to their viability.
- Broad audiences will stay current on the annual state of the forest.
- Development of informational materials and products for non-traditional clients and stakeholders will enable them to understand natural resource values and threats.

11. ENVIRONMENTAL CONSIDERATIONS

The RWU-4854 program of research includes activities that are not expected to have a significant adverse effect on the quality of the human environment. The environmental effects of specific actions will be considered during the development of study plans, at which time the existence of extraordinary circumstances related to the proposed action and any categorical exclusions will be documented as a part of the study plan as described in FSH 1909.15, Chapter 30. For research involving the use of toxicants, environmental considerations will be further evaluated through Environmental Assessments or Environmental Impact Statements prepared with, and reviewed by, the cooperating District or Forest staffs. For research having the potential to affect a plant or animal species that is federally listed as endangered or threatened or proposed for such listing, RWU-4854 will consult with District or Forest biologists and the U.S. Fish and Wildlife Service as per Section 7 of the Endangered Species Act of 1973, as amended.

Key Cooperators: The Center collaborates with research scientists, professional resource managers and academic colleagues from public and private organizations across the country to address the effects of forest threats on healthy forests. Partners and collaborators work with Center staff on the full range of activities under the three problem areas. The following list includes organizations and institutions that have participated in projects both large and small with the Center within the last three years.

Southern Research Station

Forest Assessment and Synthesis / SRS-4804 Forest Economics and Policy
Forest Assessment and Synthesis / SRS-4353 Forest Watershed Research
Forest Assessment and Synthesis / SRS-4855 Center for Integrated Forest Science
Forest Assessment and Synthesis / SRS-4952 Integrating Human and Natural Systems
Forest Restoration and Management / SRS-4158 Restoring & Managing Longleaf Pine Ecosystems
Forest Health / SRS-4156 Forest Disturbance Science
Forest Health / SRS-4160 Forest Genetics & Ecosystems
Forest Health / SRS-4552 Insects, Diseases & Invasive Plants
SRS-4801 Forest Inventory & Analysis
Savanna River Site (DOE-SRS)

Other US Forest Service R&D

Western Wildland Environmental Threat Assessment Center (WWETAC)
Northern Research Station (NRS)
Rocky Mountain Research Station (RMRS)

Pacific Northwest Research Station (PNW)
Pacific Southwest Research Station (PSW)
Institute of Pacific Islands Forestry
International Institute of Tropical Forestry (ITTF)
WO Research & Development, Inventory, Monitoring, and Assessment Research
WO Research & Development, Sustainable Forest Management Research
Forest Inventory and Analysis (FIA)

Other US Forest Service (non-R&D)

National Forest System
Southern Region (R8)
Eastern Region (R9)
Pacific Northwest Region (R6)
State and Private Forestry
Forest Health Protection (FHP)
Forest Health Monitoring (FHM)
Forest Health Analysis and Applied Sciences Team (FHAAST)
Geospatial Technology Applications Center (GTAC)
International Programs

Within USDA (not FS)

USDA Climate Hubs
USDA Agricultural Research Service (ARS)
USDA Agricultural Research Network
USDA Animal and Plant Health Inspection Service (APHIS)
USDA Natural Resources Conservation Service (NRCS)

Other Federal Agencies (not USDA)

USDI National Park Service (NPS)
USDI Fish & Wildlife Service (FWS)
USDI Geological Survey (USGS)
USGS Northern Prairie Wildlife Research Center
USDI EROS Data Center (EROS)
USDI Office of Wildland Fire
NASA Satellite Needs Working Group
US DOE Oak Ridge National Laboratory (ORNL)
US Environmental Protection Agency (EPA)

State Agencies

Alabama Forestry Commission
Arkansas Department of Agriculture - Forestry Division
California Department of Forestry and Fire Protection (CALFIRE)
Florida Forest Service
Georgia Forestry Commission
Hawaii Department of Forestry and Wildlife
Kentucky Division of Forestry
Louisiana Department of Agriculture and Forestry
Mississippi Forestry Commission
North Carolina Dept. of Agric. and Consumer Services, Forest Service
North Carolina Dept. of Environment and Natural Resources (NC DENR)
Oklahoma Forestry Services
Pennsylvania Bureau of Forestry

South Carolina Forestry Commission
State Climate Office of North Carolina
Tennessee Division of Forestry
Texas A&M Forest Service
Virginia Department of Forestry
Wisconsin Forestry Division

Universities

Alabama A&M University
Boston College
Cal-State University Los Angeles
Clemson University
Colorado State University
Duke University
Hendrix College
Indiana University
McGill University
Mississippi State University
North Carolina A&T University
North Carolina State University
Oregon State University
Pennsylvania State University
Purdue University
Tennessee State University
Tuskegee University
University of California-Davis
University of Florida
University of Georgia
University of Maryland
University of Massachusetts
University of Minnesota
University of New Hampshire
University of North Carolina Asheville
University of North Carolina Chapel Hill
University of Tennessee
University of Vermont
University of Virginia
University of Virginia
Virginia Tech
West Virginia University

Other Institutions or Organizations

ArborGen
Canadian Forest Service, Canadian Wood Fibre Center
Canadian Forest Service, Great Lakes Forestry Centre
City of Raleigh, North Carolina
European Commission, Joint Research Centre
European Space Agency (ESA)
International Paper
International Union of Forest Research Organizations (IUFRO)

Leidos, Inc
Morton Arboretum
National Cohesive Wildland Fire Management Strategy
National Council for Air and Stream Improvement (NCASI)
National Forestry Commission of Mexico
Oak Ridge Institute for Science and Education (ORISE)
Southern Group of State Foresters
Southern Regional Extension Forestry (SREF) at University of Georgia
The Jones Center at Ichauway
The Nature Conservancy
United Nations Economic Commission for Europe (ECE) / Food and Agriculture Organization (FAO) Forestry and Timber Section, Team of Specialists on Monitoring Sustainable Forest Management
United Nations Food and Agriculture Org. / Global Forest Resource Assessment
United South and Eastern Tribes
Upper Neuse River Basin Association
Wake County, North Carolina Water Resources
Weyerhaeuser Corporation

12/13. STAFF AND COSTS

The RWUD describes an ambitious five-year plan of work. The Center is currently staffed with 13 permanent employees comprising six RGEG[1] scientists (including the Center's Project Leader), two ST scientists, a communications specialist, and four professional support personnel. The staff is augmented by various cooperators, contractors, term employees, ORISE post-graduates, and summer students with the total number of supplemental staff varying annually from 11 to 15 individuals depending on funding and cooperative arrangements. The total incoming funding in 2021 for the Center from all sources was approximately $450,000 excluding funds for salary and travel support, and approximately $400,000 pass-through funds to university collaborators from the Forest Health Monitoring (FHM) program's national office and the Forest Inventory and Analysis (FIA) program. The latter funding arrangement has been renewed annually for over two decades. In recent years, an additional $500,000 in agreements and contracts to external partners further supports Center research. This total represents a mix of appropriated Forest Service research funding (FRRE), core funding provided by the National Forest System and State and Private Forestry, and supplemental funding from a variety of other sources including competitive grants.

The unit currently spends roughly equal time on the three problem areas and scientists and support staff should continue to be balanced to satisfy those obligations (**Table 1**). During the life of the unit description, proposed permanent staffing would increase the number of RGEG and ST scientists from eight to nine or ten and/or increase professional support staff from four to five or six. This increase in RGEG scientists could include an additional research ecologist specializing in conservation, planning, risk assessment or large-scale biophysical projections of forest dynamics under a changing environment. An additional research scientist or support staff who specializes in monitoring or indicators would secure advancement in problem area 1. There is additional interest in increasing the technology transfer or extension capabilities within the Center by year 3 to provide additional expertise. The current approved organizational chart for the Center (**Attachment 1**) needs substantial revision to reflect EFETAC needs.

Table 1: Staffing plan for scientist-years by year and problem area.

Problem Area	Year 1	Year 2	Year 3	Year 4	Year 5
1: Monitoring	4.3	4.3	4.3	5.3	5.3
2: Assessment	4.3	5.3	5.3	5.3	5.3
3: Exchange	4.3	4.3	5.3	5.3	5.3
Total	**13.0**	**14.0**	**15.0**	**16.0**	**16.0**

Discretionary funding decisions within the Center tend to be made along the lines of specific projects rather than allocating funds among the three problem areas. Each of the Center's various projects include significant elements of each of the three problem areas. The level of emphasis among the problem areas depends on the maturity of the project and whether it is an ongoing effort such as the *ForWarn* and *HiForm* forest disturbance monitoring projects, or a more specific project with a specified timeline and budget such as *WaSSI* national water supply project. Individual scientists and staff members are assigned to the different projects and are expected to contribute to all three problem areas. Similarly, a blend of funds from the different Forest Service deputy areas (or other sources) are used in each project depending upon the nature of the effort. For example, research funds are used primarily for foundational research and methods development. Other funding is better suited for monitoring efforts or information exchange.

[1] RGEG refers to paneled scientists covered by the Research Grade Evaluation Guide.