

2022

The Pacific Northwest Research Station Charter: A Dynamic Research Strategy for the Coming Decade



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Executive summary

The USDA Forest Service Pacific Northwest (PNW) Research Station is a leader in the scientific study of natural resources. The station's mission is to develop and communicate impartial knowledge to help people understand and make informed choices about natural resource management and sustainability. Our research improves understanding of how these complex socio-ecological systems function and how to keep them healthy and productive while balancing such objectives as reducing the risk of catastrophic wildfire, mitigating and adapting to the effects of climate change, provisioning goods and services, addressing environmental justice, and supporting the economic sustainability of communities and tribes.

In the coming years, forest and range management will be further challenged by climate change, land use change and associated urbanization, socioeconomic and demographic change, technological advances, and society's evolving expectations about how forests and rangelands are managed. Science, analysis, and communication are needed to spark insights, evaluate tradeoffs, and ultimately inform the decisionmaking that goes into policy and management.

This charter describes our science priorities, research approach, and strengths, as well as our stationwide strategy to increase our responsiveness to societal needs. It emphasizes a highly targeted, partner-driven approach for focusing and coordinating a portion of the station's program of work through a limited number of high-profile research initiatives in which scientists work together with partners to coproduce science. These initiatives will be augmented by foundational lines of research built upon the unique capacities of a federal research enterprise.

The Forest Service Manual directs agency research stations to charter their programs of work at least every 10 years to ensure alignment with statutory direction, national priorities, and regional goals. This charter represents a break from previous chartering efforts. In the interest of fostering integrative, interdisciplinary research, we are submitting a single, unified charter for the PNW Research Station that replaces the five former individual program charters completed in 2009. In doing so, we are deemphasizing program silos and encouraging broader connections and collaborations.

This charter outlines our new vision for station research based on our core values and partner priorities. We believe in the scientific method as a sound approach to knowledge discovery that ultimately enables better land stewardship. We are keen to work collaboratively to include other forms of knowledge, such as traditional ecological knowledge and professional expertise gained from working on the land. We are committed to the principles of justice, equity, diversity, inclusion, and accessibility in the performance of our work as well as the work itself. Finally, we believe in serving the needs of our partners in land stewardship, who are tasked with the challenge of caring for forests and rangelands and their ecosystem services, which help sustain, support, and fulfill human life.

With this charter, the PNW Research Station is committing to a coproduction approach to research and engagement that will foster shared ownership among partners of scientific knowledge,

information, and tools that can be applied to their real-world policy and management needs. We are organizing our lines of research around four overarching strategic priorities that our partners consistently identify as important:

- Science to manage for resilient landscapes and provide ecosystem services.
- Science to understand connections between people and natural environments.
- Science to mitigate risk to people, property, and natural resources.
- Science to monitor and predict land stewardship and disturbance impacts.

We will address these overarching research priorities through our core science work, as well as through coproduced interdisciplinary research initiatives. This two-pronged approach enables us to continue contributing basic knowledge of forest, aquatic, and rangeland ecosystems while also flexibly responding to the emerging needs of our partners, and periodically reviewing whether projects should be continued or amended. Although this charter outlines areas of research emphasis for the next 5 to 10 years, it is not intended to describe our entire program of work. We view our charter as dynamic, with a long-range vision of 10 years, a review in 5 years, initiatives that operate on 2- to 5-year cycles, and annual budget and prioritization evaluations.

This charter results from a consultative process that garnered input from partners across the region, as well as from station leadership, program managers, scientists, and professional and technical staff. It articulates a vision that unites the entire station toward producing high-impact science.

Key concepts in this charter

PNW Research Station research priorities are broad themes that reflect the key management challenges facing society and land managers, and that the station is well positioned to address through actionable science. The priorities are closely aligned with our capacities and agency priorities and objectives. They guide both initiatives and core science lines of work.

Research initiatives are targeted, 2- to 5-year coproduction efforts, with topics identified through partner input. For each initiative, the PNW Research Station will work with partners to develop a research agenda, address research questions or information needs, deliver results, and provide consultation. Initiatives can address one or more of our research priority areas.

Coproduction describes a cooperative process in which land managers, policymakers, scientists, and other partners identify specific decisions and needs to be informed by science and participate throughout the research cycle.

Core disciplinary expertise and resources maintained by the PNW Research Station support our basic and applied foundational or **core science lines of work** that are aligned with one or more research priorities. Core disciplinary expertise also supports targeted research initiative efforts, and core lines of work may feed into initiatives.

Station overview

Established in 1925, the USDA Forest Service Pacific Northwest (PNW) Research Station has supported policy and management by contributing knowledge about forest, aquatic, and rangeland ecosystems for nearly a century. Headquartered in Portland, Oregon, the PNW Research Station oversees forest and rangeland science programs in one of the most ecologically diverse regions in the United States. The station currently has 246 permanent employees, including 61 research grade scientists. Numerous other science professional and technical staff, business operations, and communication employees are vital to the work we do across 10 laboratories and 12 active experimental forest and rangelands in Alaska, Washington, and Oregon (fig. 1). Our geographic area of research spans five of the world's biomes (aquatic, forest, grassland, desert, and tundra), giving us a richly varied landscape for studying social and ecological processes, biodiversity, and the sustainable provision of natural resources. In addition, our Forest Inventory and Analysis (PNW-FIA) program's area of work covers Alaska, California, Hawaii, Oregon, Washington and six Pacific Island groups.

The Pacific Northwest Research Station recognizes that the lands where our scientists conduct research are also the homelands of numerous American Indian communities. These lands are intertwined with indigenous culture.

People living in the region have deeply rooted social, economic, and cultural ties to the land, along with diverse views of how it should be managed. For example, an increasing focus on ecological function in public land management, set against dramatic changes in the timber industry and depressed rural economies, have led to conflicting forest conservation and timber production goals. Pacific Northwest American Indian tribes have ancestral connections to the land they steward, but many face challenges in keeping these connections strong.

Public lands cover a substantial portion of the Pacific Northwest, and many of the communities we serve are rural. Combined, Oregon, Washington, and Alaska cover 21 percent of the U.S. land area but only contain 3.6 percent of the U.S. population. We have a vital opportunity to improve understanding of social dynamics, demographic trends, and the relationship between communities and with federal lands. In so doing, we have the potential to build relationships and trust in federal agencies and to develop new tools and approaches for collaborative management. Meanwhile,



Figure 1—Location of research laboratories and experimental forest and rangeland sites of the Pacific Northwest Research Station.

population growth in urban areas, particularly in Seattle and Portland, means that more people than ever are seeking to access public lands for recreation, and land managers seek ways to incorporate the public's shifting values and priorities.

Our mandate to support natural resource policy and management, combined with a relatively stable funding structure over the decades, has allowed us to address big-picture watershed- and landscape-level management issues over long periods. Recent research affirms the value and significance of taking a long-term view of social and ecological systems in addressing broad, cross-ownership issues such as climate change and wildfire.

The need for a fuller understanding of forest and rangeland ecosystems has only grown in importance. The deeper and wider our knowledge base, the better we can provide timely answers to high-priority questions as they emerge. Shared long-term datasets, scientific expertise, and institutional knowledge enhance our ability to respond quickly to partner requests and changing environmental, social, and ecological dynamics.

Mission and values

Along with the other research units in Forest Service Research and Development, the PNW Research Station has a distinct mandate to support the agency's land management community. We bring scientific knowledge, information, and tools to help decision makers develop and weigh science-based, natural resource management options. Science can provide an objective lens for evaluating the social and ecological consequences of past and future management actions on the land. The clearer our understanding of these consequences, the more confidence we can build in new management choices—choices that can better balance conflicting values people hold for natural resources. Drawing on scientific evidence is also essential to civic dialogue, especially when competing interests are as fluid and dynamic as they are today.

Our mission: The PNW Research Station is a leader in the scientific study of natural resources and the people who interact with and rely on them. We develop and communicate impartial knowledge to help people understand and make informed choices about natural resource management and sustainability.

Partner-driven research and science delivery

We undertake our work in partnership with our agency's National Forest System and State and Private Forestry deputy areas; as well as other local, state, and federal agencies; and policymakers, tribes, universities, private industry, and nonprofit entities. We refer to these groups collectively as *partners* in this document, with the realization that the term broadly encompasses a range of relationships, collaborations, and information users. The PNW Research Station's continued relevance depends on our ability to anticipate partners' information needs, and to be visionary in planning for the future direction of station research (see appendix for examples of partners with whom we routinely engage).

While our scientists have always developed mutually beneficial relationships with users of our information, we are embarking on a more deliberate and strategic approach to meeting information needs. This charter implements a dynamic process—piloted in 2019—that guides the station in continually identifying and addressing the emerging information needs of partners.

We envision that working intentionally and closely with partners fosters our joint understanding of forest, aquatic, and rangeland systems and people's interactions with these ecosystems. The forests, rivers, and rangelands that provide our clean water, clean air, wood products, food, medicines, recreation opportunities, and biodiversity are the life-support systems of the planet. Healthy forests, rivers, and rangelands support healthy people, and sustaining these ecosystems is essential to sustaining quality of life. By supplying the best available science to help maintain these ecosystems, we benefit all Americans.

All lands

Our mandate is to conduct research across all lands, including private ownerships, tribal lands, and public lands managed by federal agencies, states, and municipalities. Our cross-jurisdictional mission, science capacity, and history of working in cooperation with partners give us a critical role to play in meeting the USDA vision for shared stewardship. This role is refined and validated in state-level shared stewardship agreements with Oregon and Washington: working across land ownerships to do the right work in the right place at the right scale. We have the ability, if needed, to act as co-conveners for collaborative learning.

Our all-lands mandate is also supported by our unique relationship with two entities housed within and supported by the PNW Research Station: The [Western Wildland Environmental Threat Assessment Center](#) and the USDA [Northwest Climate Hub](#). In addition, PNW Research Station's Forest Inventory and Analysis (PNW-FIA) program is an all-lands partnership responsible for monitoring the health of forests in California, Hawaii, Alaska, Oregon, Washington, and the U.S.-affiliated Pacific Islands. Our innovative science often has national and international applications for natural resource sustainability, with such liaisons elevating the scope and efficacy of our efforts.

Diversity, equity, and inclusion

We seek to explicitly advance diversity, equity, and inclusion in the research we conduct, in our approach to partner engagement, and in our interactions with each other internally. Because these issues are so important, we have acted on several fronts:

- We commit to fund and maintain the Employee Voice and Action (EVA) group, a grassroots team of employees that works to address cultural and institutional barriers to diversity, equity, inclusion, justice, safety, and security in our work environment. EVA strives to foster a workplace in which all employees feel safe, secure, valued, respected, and supported for delivering the mission of the station.
- Our partner-driven approach to research engages many different voices as we define the questions

We are guided by the core values of the agency—values that reflect the heritage of the Forest Service, expressed in the language of today's workforce. We believe in:

Service. To each other. To the American people. To the planet.

Interdependence. Of all things. People and nature. Communities and colleagues. The past, present, and future.

Conservation. Protection when necessary. Preservation when appropriate. Restoration, when needed, and wise management for multiple use and enjoyment always.

Diversity. People and cultures. Perspectives and ideas. Experiences and ecosystems.

Safety. In every way: physical, psychological, and social.

we will focus on and the problems we will address. We aspire to make our research and development efforts available across racial and socioeconomic lines by engaging diverse groups and producing information and tools that meet the needs of an increasingly diverse population. This includes recognizing and incorporating different knowledge systems, such as traditional ecological and experiential knowledge.

- We have a growing body of research that focuses on traditionally underrepresented groups, including low-income, indigenous, and people of color. This research is designed to increase understanding of the impacts of Forest Service management on these populations; improve opportunities for them to use national forests and grasslands and engage in collaborative management; support managing for their diverse social, cultural, and economic relations with natural resources on Forest Service lands; and provide insight for integrating traditional and local ecological knowledge into forest and rangeland management. To encourage scientists to work on these kinds of issues, EVA manages a Research for Underserved Communities Fund to support research that both involves and benefits underserved populations.

Management challenges and need for research

Addressing the toughest challenges in natural resource management requires investments in fundamental and applied research. The future will be influenced by myriad social, environmental, economic, and technological trends and events—none of which can be predicted with complete accuracy. However, some overarching forces have changed conditions in the past, are influencing the present, and are anticipated to continue to do so in the future. These include broad-scale and global environmental hazards to natural ecosystems and human health such as climate change, stratospheric ozone depletion, invasive species, loss of biodiversity, changes in hydrological systems and freshwater supplies, land degradation and fragmentation, urbanization and development, and stresses on food-producing systems. Further, we acknowledge that land managers face sociopolitical challenges, land use change, demographic shifts, and transitioning economies. Additionally, there are pressures on recreation, subsistence, and culturally important resources created by unanticipated events such as a global pandemic or rare but consequential natural disasters.

Climate change is the defining issue of our time. The vast majority of our partners desire more information and solutions around the impacts of climate change on ecosystems and society. There is particular urgency around developing “climate-smart” forest management approaches and fostering workable adaptation and mitigation strategies for communities. Many of the problems that natural resource professionals will face in the coming years will be exacerbated by climate change.

Specifically, our partners need science to improve their understanding of the interactions between climate, forest and rangeland dynamics, and other influences. This includes science that enables them to project the likelihood and impacts of future conditions as accurately and precisely as possible given considerable uncertainties, both at regional and finer spatial and temporal scales. Work on multiple interacting stressors such as wildfire, drought, and invasive species in the context of changing climate regimes is particularly needed.

Questions our partners ask include:

- What management strategies and actions can we use for adaptation and mitigation?
- How might forest and grassland management strategies be modified to incorporate carbon policies and markets?

- What are the probable impacts of climate change on people, natural resources, water availability, vegetation, disturbance regimes (insects, disease, wildfires, invasive species), wildlife and fish habitats, and nontimber forest products?
- What policies and land management practices can mitigate greenhouse gas emissions?
- How do we reduce or eliminate greenhouse gas emissions from our management operations?
- How can we incorporate climate change science and strategies into planning, including National Forest System land management plan revisions and state forest action plans?
- How can we help tribes and rural communities plan for and adapt to climate change?

Wildfire can be damaging, deadly, or beneficial for people, property, and natural resources. Wildfire continues to be a priority topic with a myriad of different information needs in the Pacific Northwest, Alaska, and elsewhere in the West. For example, our partners would benefit from clearer understanding of fire's effectiveness as a silvicultural and stewardship tool and its influence at the landscape level. This knowledge needs to be tailored to specific forest types, from the rainforests near the Pacific coast to the dry forests of the interior West, allowing us to identify forest types in which our envelope of acceptable land management practices can substantially affect wildfire size, frequency, severity, and extent.

Partner information needs also include social and economic research that identifies strategies for management of fire-resilient landscapes. These strategies will not be feasible without public support for forest management tools that mitigate the risk of fire. Social science research is needed to understand community values, interests, and perceptions related to forests and wildfires and the public's willingness to accept and participate in wildfire risk mitigation strategies. Supporting communities that are ill-prepared for wildland fire or lack robust fire management resources is particularly important as wildfires have begun to encroach into areas where they historically have not occurred or have occurred infrequently.

Questions our partners ask include:

- How will climate change alter the fire regimes in the region?
- How does wildfire and prescribed fire affect vegetation, or fish and wildlife habitat?
- What is the efficacy of managing wildfire at different scales?
- What can we expect from novel postfire ecosystems?
- How do climate cycles influence the weather events that alter regional wind patterns and increase fire risk?
- How might multiple jurisdictions best manage wildfire in the wildland-urban interface and across land ownerships?
- How and where should management promote tree reestablishment after fire?
- What are the differences in fire ecology in east- versus west-side forests, and what actions are appropriate to mitigate fire risk to values in these areas?

Socioeconomic and cultural issues and their influence on public perceptions of policy and management are consistently identified as pressing information needs. More social science is needed to understand the roles of forests in urban areas, and how forest and rangeland policy and management affect rural natural-resource-based communities and culturally important issues for American Indians and Alaska Natives.

Recreation and outdoor experiences are also at the forefront in the minds of resource managers as they work to balance increasing demand and new types of demand with environmental protection. The

American public has sought relief from the COVID-19 pandemic on their public lands, and public lands will remain a popular destination for many. Managers need more information about how people use forest landscapes and what draws people to visit or even relocate to wildland places, as well as information on how to balance and address conflicts between overlapping uses and natural resource impacts. For example, there has been a socioeconomic shift in southeast Alaska over the past 15 years from a timber-based economy to one based on tourism and recreation. Research on this changing market is needed, as well as whether economic benefits are equally distributed to Alaska Native communities. As demographic and socioeconomic characteristics of the U.S. public continue to change, managers seek ways to ensure equitable access to recreation resources and opportunities for people across all ages, ethnicities, and backgrounds.

Other social science needs involve private landowners, their values, and how they manage private lands. Our state and forest industry partners are concerned about the loss of forestland to development. As the recent wildfire seasons have shown, there are many challenges associated with our current patterns of land use, with multiple ownership types and a mix of land management objectives. Our partners are interested in shared governance, stewardship, and joint decisionmaking, and are asking us to continue investigating the nature of complex ownership patterns and management objectives. Our work often takes place across multiple jurisdictions and can help networks of landowners and organizations speak the same language and reduce the complexity of their decision space.

Questions our partners ask include:

- How can we maximize economic gains while minimizing environmental impacts of forest management across forest ownerships?
- How willing or able are private landowners to contribute to mitigating climate change or wildfire risk?
- How do we balance national expectations for use of public lands against local needs such as grazing, recreation, harvest taxes to counties, or carbon sequestration?
- How do individual land managers work together to achieve common fire protection and fire risk mitigation objectives?
- To what degree are we managing our lands in a manner that equitably distributes benefits across racial, demographic, and economic lines?

Other common information needs from partners over the years include forest management effects on water supply, future water availability, risks of invasive species infestations and other forest health issues, smoke and air quality, integrating ecosystem services into management, subsistence culture and economics, biodiversity, landscape-scale approaches, and the need to rebuild public trust in the Forest Service as an agency.

Strategic research priorities

The complicated social and environmental context that drives land management challenges also determines the priorities for the USDA, the U.S. Forest Service, Research and Development, and the PNW Research Station. Figure 2 demonstrates the hierarchical nature of these layers of priorities, which are necessarily dynamic.

Each of the PNW Research Station's four broad science priorities describe persistent land and natural resource management issues that are thorny, multifaceted, and timeless enough that our work on these subjects will be relevant for decades to come. We have crafted these priorities to articulate our science

and delivery goals and align our research investments with agency priorities.

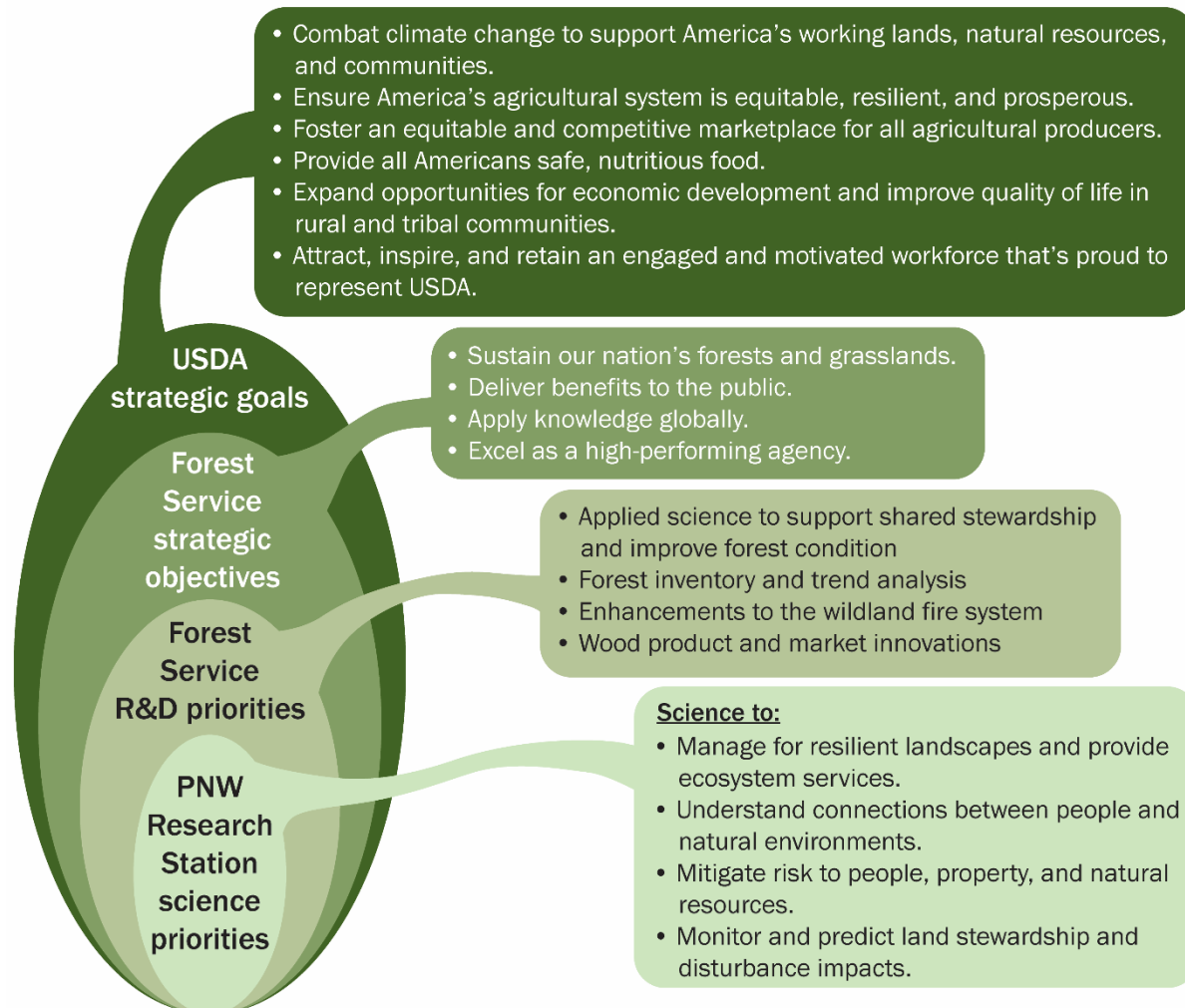


Figure 2—Hierarchy of strategic goals, objectives, and priorities that informs PNW research and our charter. These goals, objectives, and priorities reflect the time of this charter writing (winter 2021) and will likely change in the future, underscoring the need for dynamic and responsive research approaches.

Justification and priority selection

The process for identifying our four research priorities was informed through high-level partner sensing. Throughout the year, station leadership engages both formally and informally with policy makers, land managers, and other partners to identify the critical information needs that can be met by new research in the social and natural sciences. We maximized inclusiveness and rigor in this process by soliciting feedback from an extensive community through repeated engagements.

After collating information needs from partner engagements, as well as information needs we heard through program reviews (2016-2017) and the Forest Service Deputy Chief for Research's review (2017), the Station Management Team identified broad themes that rose to the top, and evaluated them against our science capacity to determine which themes made the most sense to pursue (see appendix for more background). These broad themes became our four research priorities. They align well with

national R&D priorities introduced in 2019 linking the overarching corporate priorities to a Pacific Northwest context.

This charter focuses on our research and development activities and the production of outcomes relative to these four research priorities. Funding will be allocated to support multidisciplinary research that furthers our knowledge and assures our research is responsive to partner-identified priorities. Research priorities are a convenient way to organize and describe our research, not as definitive boundaries, but as a collective body of work that is relevant to partner needs. Individual research efforts will often address two or more research priorities. Planning research within the context of research priorities emphasizes the flexing of disciplinary capacity to meet multidisciplinary research needs, with scientists and support staff operating in a matrixed environment. Conversely, it deemphasizes planning toward fixed organizational units that are constrained by geography or discipline.

Priority 1: Science to manage for resilient landscapes and provide ecosystem services

The context for public lands management is complex and results from interactions among social, environmental, economic, and technological drivers of change. One key challenge land managers face is understanding these drivers of change, how they affect local and landscape-level processes and the provision of ecosystem services, and how to apply that information to management. Our partners consistently ask us for applied, manager-responsive, social and ecological knowledge, tools, and best management practices to advance the resilience of forest, rangeland and aquatic ecosystems; economies; tribal lands; and rural communities. We define resilience as the capacity of social and ecological systems to return to a desired state following exposure to a stressor or disturbance.

One goal of protecting and enhancing the resilience of forest, rangeland, and aquatic ecosystems is to ensure these systems continue to provide the commodities and ecosystem services society depends upon. The research program of the PNW Station has already made enduring improvements to our knowledge of these ecosystems. For example, our work on riparian systems has led to breakthroughs in stream restoration. Thanks to the station's research, we have a much better understanding of the critical role of large instream wood in creating complex aquatic habitat, the importance of diverse food webs, and the utility of structures that mimic beaver dams in restoring degraded streams.

As the geographic extents and timeframes of our research have expanded over the decades, more attention has been paid to habitat connectivity and complexity, two critical factors in ecosystem resilience. This has changed the scale of our thinking, as we now seek ways to work across ownership boundaries to support habitat complexity, connectivity, and heterogeneity, as well as biodiversity wherever possible.

The need to prioritize research related to resilience and ecosystem services grows, particularly as we see the increasing frequency, size, and intensity of wildfires and ever stronger pressure from climate change. There is broad agreement that for most dry forest types in the West, postfire forest resilience is less than in the past. In some areas, forest condition is declining despite restoration efforts. There is also broad scientific agreement that fire is one of the most essential influences on western forests and that it needs to be restored to most landscapes through the use of prescribed fires under specific conditions. Managers need information and tools to create landscape conditions that favor desirable fire behavior at broad spatial scales, as well as techniques to overcome a multitude of barriers that prevent widespread implementation of established beneficial management actions. We also need to understand how to prepare for more wildfire, and how climate change will alter future fire regimes.

The PNW Research Station is well situated to fill these needs. Ever since the Northwest Forest Plan, the station has pioneered broad-scale, landscape-level assessments that cover extended time periods—broadening our frame of reference for understanding and managing complex ecosystems and the goods and services they provide. We also have a great deal of expertise with decision support. Our tools and models have helped make decisions about how and where to target forest restoration to enhance ecosystem resilience and address multiple objectives at once.

Outcomes of work under this priority:

Outcomes of this work will include basic knowledge, applied science, and cutting-edge tools to enable decisionmakers to take actions that better the lands they manage for multiple uses, even in the face of a fundamentally uncertain future. Our work can be used to support shared stewardship goals and management actions aimed at improving forest, range, and aquatic ecosystem conditions, including restoration of fire-prone forests, developing ecosystem resilience after fires, and restoring degraded stream systems.

Priority 2: Science to understand connections between people and natural environments

Humans and their preferences, behaviors, and livelihoods are embedded in the natural world. Therefore, forest and range landscapes contain webs of economic and social relations that link individuals and communities to places. These connections can complicate the decision space of natural resource managers, sometimes leading to conflict or even legal opposition. When diverse and complex sets of values and expectations must be addressed, decisionmakers are challenged to make universally satisfying decisions. In the past few decades, our partners have consistently identified social and economic research as a pressing information need. Decisionmakers and planners need up-to-date information on how people value and use public lands, and the goods and services they provide such as water, wood products, livestock forage, fish, wildlife habitat, recreation opportunities, culturally important resources, food and fuel sources, and carbon sequestration.

Working across disciplines is a critical part of this research priority because partners repeatedly tell us they could make better sense of the “triple bottom line” (economic, ecological, and social sustainability) if socioeconomic research could be better integrated across all research areas. There is also a need to expand the diversity of viewpoints in natural resource decisionmaking and develop models for shared stewardship. How do we ensure that people have an opportunity to participate in decisions that affect their livelihoods, lifestyles, or areas of cultural and spiritual significance? How do we make planning and the science that informs planning more accessible and meaningful, particularly for vulnerable communities and those traditionally not represented in planning processes?

Currently, land managers in our region see a surge in recreation use by the public and are struggling to understand changing demands. Tools, frameworks, and models are needed to help managers at all levels of the agency structure opportunities for meaningful public engagement and plan for recreation use that allows visitor access to nature and encourages a diversity of people to experience the benefits of nature while protecting ecosystems.

Understanding the different uses and meanings that people have for the landscape is important for developing and supporting forest and rangeland management plans that are socially and ecologically sustainable. The PNW Station has a strong background in social and economic work that includes studies of the role of trees, forests, and other plants for urban residents; valuation and use of forest products, ecosystem services, and recreation; drivers of land use change; and management approaches that

support sustainable livelihoods and rural communities, honor indigenous connections, and emphasize collaborative management of federal and nonfederal land.

Outcomes of work under this priority:

This work builds on our social science strengths in environmental economics, sociology, anthropology, and related disciplines to support management and policy decisions through improved understanding of interactions between socioeconomic and biophysical systems at landscape scales. Outcomes of this work might include new information about outdoor recreation visitation and tourism trends and how best to monitor them; market opportunities for forest products from Alaska and the Pacific Northwest; the benefits of trees, forests, and nature and the ecosystem services they provide; ways in which people adapt to and mitigate risks associated with wildfire, climate change, and other disturbance; and the sustainability of rural and urban communities.

Priority 3: Science to mitigate risks to people, property, and natural resources

Landscapes are vulnerable to various disturbances that shape the composition, productivity, distribution, and structure of forests, rangelands, and aquatic ecosystems. Natural disturbances, such as wildfires, floods, landslides, volcanic eruptions, earthquakes, and insect and disease outbreaks, are normal and necessary drivers of ecosystem function that helped shape the evolutionary trajectories of our landscapes and watersheds. Their intensity or periodicity may be on altered trajectories, however, requiring further research and potential mitigation. Human-caused disturbances may be intentional, such as a timber harvest or development, or unintentional, such as air pollution or the interacting effects of climate change, including extreme drought. Human activities may also increase the magnitude, frequency, and severity of natural disturbances.

The interactions of multiple risk factors add complexity to disturbance research. Within this large context of heterogeneous disturbances, key risks have emerged for focused attention. Key risks can vary by geographic scope, ecosystem type, or ecosystem service, and different risk research emphasis may be elevated by diverse science disciplinary arenas.

Climate change has emerged as an overarching factor with broad reach and depth of projected impacts, with the potential to dwarf all other disturbances in scope and scale. Climate change is the defining issue that will greatly influence the way we manage land and natural resources for the foreseeable future. It will continue to be a cross-cutting priority for our work because forests and rangelands are central to climate mitigation and adaptation. Future climate impacts are highly uncertain, dependent on the greenhouse gas emissions pathway we take as a global society. Under any given scenario, climate change impacts are anticipated to vary across the region and affect many important forest and rangeland disturbances and processes, including hydrology, flooding, and drought; invasive species; forest insect and disease outbreaks; fire regimes; species distributions including local extirpation or extinction; and human settlement and land use patterns.

Already, much of our work supports “climate-smart” management. The PNW Station has a long history of climate research aimed at tackling climate change. We developed the first climate change adaptation guide for any federal agency, providing the scientific foundation, tools, and processes needed by all national forests to adopt climate-smart forest management. We have long-established genetics research as well, which helps us understand genetic diversity and adaptive variation. Also, our scientists excel at ecosystem modeling, fire-climate interactions, and assessing climate effects on vegetation. We support two climate science and application centers: the [Northwest Climate Hub](#) and the [Western Wildland Environmental Threat Assessment Center](#). These complementary centers allow us to leverage our core

climate science capacity and provide managers with a structured, all-lands approach to engaging scientists and partners in delivering climate science and landscape-scale assessments.

Nonetheless, observed and anticipated regional impacts from climate change will create unprecedented challenges for natural resource management. We need to provide more science information and tools to help land managers prepare for unlikely yet catastrophic events and support management approaches and rural communities in a world that is being increasingly disrupted by extreme weather and other climate-related disturbances.

The potential breadth of impacts and interactions from climate and other drivers of change means that successful adaptation and mitigation efforts will require collaborative efforts that unite diverse disciplines. Therefore, we will collaborate with national forests; tribal, state, and federal agencies; regional landscape-scale climate collaboratives; and other partners to support climate-smart management and planning in the Pacific Northwest and beyond.

Outcomes of work under this priority:

Research results under this priority area will contribute to fundamental scientific knowledge and support science-based management of ecosystems to avoid, adapt to, or mitigate key environmental threats and their consequences, especially those related to climate change, wildfire, invasive species, and insect and disease outbreaks. Our work will also address the cause, detection, prevention, and effects of disturbances and interactions of disturbances across multiple scales. Outcomes will include decreased risk of catastrophic loss to communities, ecosystem services, and economic disruption from disturbance, including fire, insects and disease, invasive species, drought, and flooding.

Priority 4: Science to monitor and predict land stewardship and disturbance impacts

Monitoring provides the basis to gauge and react to change, whether human-caused or natural. The science of monitoring uses innovative technologies and techniques to offer a view before, during, and after changes in landscape conditions and ecosystem processes. Because the PNW Research Station continues long-term studies and monitoring that began decades to centuries ago, we are able to quantify basic processes, such as vegetation growth rates for the past 100 years and effects of competition as well as successional dynamics following disturbances, all of which can be challenging for species that live 500+ years. At certain experimental forests and rangelands, watershed experiments implemented in the 1950s continue to yield new findings and attract worldwide interest. Our long-term data are what enable us to validate changes associated with climate change from other potential drivers.

Monitoring forest attributes such as species composition, forest conversion, ecosystem indicators, the status and trend of wildlife and fish, and forest health provides foundational data that can be used in a variety of research on forest status and trends. This research priority also encompasses the PNW-FIA program, responsible for the inventory of approximately 570 million acres (230 million hectares) of public and private land. Providing an annual inventory of forested lands as well as periodic assessments of the status and trends of forests are key products of the program that are in high demand by state and federal land managers, nongovernmental organizations, financial investors, tribes and native corporations, and private landowners.

In addition, research under this priority will provide techniques and policy-relevant information that can link other types of monitoring methods to the long-term PNW-FIA research network. For example, continuous mapping of ecosystem attributes, assessments of biofuel availability, assessments of

nontimber forest products in Hawaii and the Pacific Islands, and carbon assessments for cap and trade markets such as California's all depend on inventory and monitoring data.

Beyond the development and improvement of monitoring techniques, work in this priority will also address the monitoring of plant and animal populations in both terrestrial and aquatic systems; examine subsurface processes and carbon fluxes; and examine and predict responses to climate, disturbance, environmental toxins, insects and pathogens, and management actions and policies.

Outcomes of work under this priority:

Research supporting this priority will improve our ability to quantify change in forest and rangeland conditions over regions or management units. Our work will result in tools that integrate ground and remotely sensed measurements to provide estimates of vegetation, habitat attributes, and at-risk fish and wildlife populations; and project the effects of likely management and disturbance scenarios. We will also develop new tools and techniques to facilitate comparative studies seeking to understand or model changes in natural resources through time and across landscapes. Outcomes have the potential to strongly influence carbon management policies in the region and nationally.

Research priorities: current and proposed work

For each of the four research priorities, there is a strong body of research that has served and continues to serve to inform modern forest management both in the US and internationally. This foundation reflects the long-term resource investments and disciplinary expertise required to carry out successful research that addresses the four priorities. See table below for specific ongoing and planned work.

Table 1. Current and proposed work related to each of the research priorities for FY22.

Research priority: Science to manage for resilient landscapes and provide ecosystem services.
Starkey Experimental Forest and Rangeland ungulate ecology
Annual GNN mapping to support post-fire planning
Climate change in coastal riverscapes
Links among forest stand age, fire severity, and aquatic biodiversity
Tongass-wide young growth study (TWYGS)
Genomics of local adaptation in trees
Three-dimensional fuels characterization to support physics-based fire models
Detection, monitoring, and management of forest pathogens in the western USA under changing climates
4CAST project: Plant phenology and pollination on the Oregon Coast
Research priority: Science to understand connections between people and natural environments
Homelessness on public lands: social and health needs

Outdoor programs for military veterans
Community forests, forest conservation, and rural prosperity in the U.S.
Climate impacts on recreation and public use in the Chugach NF
Pandemic effects on tourism communities in Alaska
Managing livestock and wolves on national forests in the West
A path towards net-zero energy communities in Southeast Alaska
Mountain loop recreation visioning
The value of birds of the Pacific Flyway to birdwatchers
Southeast Alaska forests, fish, and people
Olympic and Kitsap Peninsula prairie ecology and mapping
Research priority: Science to mitigate risks to people, property, and natural resources.
Elk population reduction-predator interaction effects on mule deer
Western Oregon flow permanence: navigating drought and its consequences
Community smoke model development with partners
Weather systems driving extreme fire events
Understanding fire plumes using computational fluid dynamics and observations
Satellite data fusion and assimilation for air quality
Alaska salmon fisheries valuation
Elodea in Copper River delta
Pyromorphometrics: development and evaluation of relevance to fire growth
Vegetation and fuel dynamics following fire in dry coniferous forests
Effects of wildfire and forest restoration on northern goshawks
Research priority: Science to monitor and predict land stewardship and disturbance impacts.
Landscape-scale evaluation of white-headed woodpecker response to forest management

Effects of the Holiday Farm Fire on long-term forest dynamics plots in second-growth, mature, and old-growth forests
Regional meta-analysis of management effects on fire severity
Effects of forest restoration on northern spotted owl prey in the eastern Cascades
UAS TIRS imagery to quantify tree vigor
Subalpine fir decline
Using social media and crowd-sourced data in recreation monitoring
Using COVID-19 to improve understanding how disturbance influences recreation behavior

Research approach

For nearly a century, scientists at the PNW Station have been building on the strengths of past scientific discoveries and advancing knowledge of biological, physical, ecological, sociocultural, and economic relationships in forest and rangeland science. The sum of this work has been greater than the impact of each individual study—it is the foundation of our understanding of these complex forest and rangeland socio-ecological systems.

Achieving research outcomes that can be applied to natural resource problems requires orchestrating all the components of science, from partner engagement to conducting studies to delivering results in ways that can be readily used in management and policy development. Just as many components are required to complete an individual study, there are different ways to approach selecting future research topics and conducting research. In the traditional model, a research project is initiated by a scientist or science team who selects the research question, designs the study, procures funding, implements the study, and delivers the results. The team might collaborate with scientists at universities or other agencies to do the work, and frequently establishes relationships with the partners who are interested in using the work. This approach has been a fertile area for cutting-edge science from the station, even when the topic is not yet on the radar of land managers.

Although the station continues to address some of the thorniest problems facing society, science-based management of these issues is often complicated by information overload. In this context, we are striving to diversify how we conduct and deliver our program of work. Specifically, we want to work more closely with partners and enlist them in helping frame issues impactful to them, so that our research can be more readily understood and relevant. Therefore, in addition to the traditional approach, we are also promoting and emphasizing a new and more targeted approach—[coproduction](#).

Coproduction describes a cooperative process in which land managers, policymakers, scientists, and other partners identify specific decisions to be informed by science. Then they jointly define the scope and context of the problem, research questions, information needs, methods, and outputs; make scientific inferences; develop targeted deliverables; and craft strategies for the appropriate use of science. Our partners have expressed a strong interest and enthusiasm to collaborate with scientists throughout the research cycle, including in the design of science delivery and real-time consultation.

Dynamic partner-driven research initiatives

Research-management collaborations have a long history at the PNW Station. We were the first station to have science liaisons (positions shared between the station and the Pacific Northwest Region [Region 6]), and we have a history of adaptive management partnerships going back decades. Taking what we have learned from these experiences and expanding on them, we have embarked on a new approach centered around research initiatives that function as dynamic partnerships between scientists and end users. These initiatives are designed to elevate carefully chosen research projects that address our partners' immediate management challenges through the coproduction approach. We are implementing a transparent process for identifying initiative topics that address the most critical information needs and priorities.

To successfully coproduce science, we rely on our strong existing partnerships and new relationships we are building to get inclusive input on the highest priority issues of the day. With that in mind, we strategically and deliberately scope out the research and information needs of key partners, including Forest Service Regions 6 and 10; tribal governments; and state, industry, and nongovernmental partners. A team of station leaders and scientists, informed by the input gathered in these engagements, evaluates future initiative topics using a set of criteria (see sidebar).

After a topic is selected, the research initiative is developed by partners and station researchers working together to identify and prioritize researchable questions that can be addressed within 2 to 5 years.

The station allocates resources to fund research initiatives, while also recognizing the roles and capacities that other institutions can contribute toward accomplishing objectives and advancing mutual interests. We piloted this approach with two research initiatives (see sidebar below) in 2019 and will be launching a third initiative in 2022 titled Community Socioeconomic Well-Being and Resilience in Southeast Alaska.

Criteria for selecting a research initiative topic:

- The topic is a high priority for a key partner for at least several years and is relevant to the station's mission.
- The project lends itself to coproduction, with the potential for innovative science and synthesis.
- The work addresses complex, multi-disciplinary questions, and is achievable during the initiative period.
- The initiative builds on PNW Research Station science capacity and leverages existing information or efforts.
- Outcomes are achievable within 2-5 years.

Approach to problem solution

The work associated with the coproduced research initiatives entails problem analyses that outline clear lines of work, deliverables, and the staffing and resources needed to achieve them. These analyses provide a mechanism for coordinating with the WO, responding to national research reporting requirements such as RITS and CRIS, and establishing responsive new lines of work on problems that our partners face. This targeted and collaborative approach serves to elevate and communicate our research to partners and assures that it is relevant and put to use.

In addition to helping us identify our overarching [research priorities](#), partner sensing also helps us frame well-defined questions of inquiry. Once we have researchable questions defined, problem statements are then established for the collaborative research initiatives. At that point we can begin to develop the body of research studies to be coproduced along with partners. Given the co-development emphasis, the dynamic timeframe for initiatives, and the potentially complex, multi-themed research questions within an initiative, distinct problem analyses will be developed for each research initiative.

Research priority portfolios are defined for the 10-year horizon of the charter with a review at five years. Therefore, research priorities will establish a foundation for the program of work for at least five years. Research initiatives are a more dynamic programmatic element with two- to five-year horizons. Problem analyses will be prepared by the program manager aligned to the research initiative, the assistant director for research, and a team of scientists having disciplinary relevance to the initiative (see below for more detail on roles).

Problem analyses are dynamic tools for research planning and will be revised as priorities and initiatives evolve. Problem analyses include: 1) articulation of the problem based on review of literature; 2) description of proposed research; 3) breakdown of problem into prioritized study components; 4) any environmental considerations; 5) identification of cooperators; 6) expected costs and returns to research users; and 7) technology or knowledge transfer plan.

In addition, we will address Forest Service R&D recommendations for coordinating the research planning process to improve alignment with national priorities, ensure accountability, and enhance transparency and efficiency. We will emphasize the following components of research planning:

- *Outcomes:* We will focus on desired outcomes and potential impacts that allow reviewers and decision makers to identify opportunities to support or adjust multi-year programs of work within the core capacities and the research initiatives.
- *Integrity:* We will ensure that planning and budgeting processes protect the integrity of the research process, support production of relevant and influential science, and provide support to researchers in meeting RGEG requirements and attaining professional recognition.
- *Coordination and alignment:* The PNW Research Framework enables coordination and alignment of our research with other stations, and includes consultation with partners to effectively meet regional and national goals and objectives. We will coordinate with national program leads in the research planning process.
- *Accountability and reporting:* The PNW Research Framework is designed to focus our research planning process on balancing current commitments with the need to be responsive to contemporary partner needs. Our problem analyses will provide a transparent written record of our commitments and accomplishments to meet reporting requirements and for any other evaluations of R&D activities, products, costs, and benefits.

Current research initiatives

In 2019, to strengthen collaboration with National Forest System and other partners, we launched the following pilot initiatives:

Carbon dynamics for land and watershed managers

The Western states including Washington, Oregon, California, Alaska, and Hawaii are leaders in carbon markets. This research initiative aims to address unresolved questions regarding carbon dynamics, accounting, and the sequestration potential of carbon in Pacific Northwest forests and watersheds. Another goal is to cultivate long-term relationships with partners. State agencies have been major proponents of this work and acknowledge the tremendous need for National Forest System involvement given the desire to manage across boundaries, and that our agency stewards the most extensive carbon stocks and potential for flux in the region.

Priority topics were identified and translated to research projects addressing the following goals:

- Design carbon management scenarios to model in carbon management and policy assessment.
- Review and synthesize carbon models for application.
- Project harvested wood products and substitution effects from modeled scenarios.
- Identify landowner/manager responses to incentives and scenarios.
- Explore compatibility/tradeoffs between managing for carbon and other forest management goals.
- Assess barriers and opportunities for promoting carbon-oriented forest management by public, tribal, and private landowners.
- Synthesize and publish a literature review of Pacific coast carbon scenarios, modeling efforts, and management and disturbance impacts.

West-side fire and climate adaptation initiative

The station initiated the west-side fire and climate adaptation initiative to respond to growing concern about increasingly frequent large fires in mesic, jurisdictionally complex forests on the west side of the Cascade Range in Oregon and Washington. The initiative's primary goal is to provide actionable science that improves wildland fire management decisionmaking in these complex landscapes.

Priority topic areas identified by scientists and practitioners include the following:

- Historical and future range of variability of wildfire.
- Marine layer influence on extreme fire weather.
- Understanding landowner decisionmaking about wildfire management on their properties to mitigate hazard and risk.
- Strategic fuel management and treatment effectiveness.
- Fire effects on aquatic habitat.
- Postfire management.

Following the uncharacteristic fire season of late summer 2020, the research-management teams augmented the original study plans to incorporate work that can help in newly identified recovery and restoration efforts.

Community socioeconomic well-being and resilience in Southeast Alaska

The station recently added an initiative exploring community socioeconomic well-being and resilience in Alaska. Specific information needs are focused on Tongass National Forest communities and the forest products industry, including exploring current community socioeconomic conditions, potential small-diameter forest products and markets, contemporary rural subsistence patterns, and community-level impacts of the transition from predominantly old-growth to young-growth timber harvest. This initiative is currently under development.

Station alignment

The operational model of the PNW Research Framework sufficiently and efficiently ensures that we can meet agency direction through a single charter. This model will require minor realignment of current research programs to the research framework priorities, with employee supervision and administration grounded in disciplinary core capacities, business operations, and communication and applications.

The graphic below illustrates how administration and supervision of science personnel will be organized across six core capacities. We designed the supervisory structure to balance employee-supervisor ratios, increase disciplinary alignment, improve supervision quality, and cultivate motivated and supported employees. In addition, this organizational structure allows us to meet accountability, reporting, and administrative requirements as follows:

- Science direction arises from initiative leads, core capacity leads, or individual scientists.
- Problem analyses are focused on the research initiatives, and CRIS/RTIS reporting is aligned with the four research framework priorities.
- Project study plans are aligned with research initiatives and collected by core capacity for non-initiative research.
- Science personnel administration and supervision are aligned with core capacities.

Administrative roles

This charter reflects the station's shift from five distinct research programs to a "program of work" model in which appropriated resources are directed to four clearly identified research priorities. Programs as previously conceived will be reorganized into four priority research portfolios, each with oversight and direction from a program manager. This framework is organized around partner feedback and enables more targeted and timely responsiveness to their information needs.

Program managers

Broadly speaking, **program managers** (PMs) have two defined roles that operate independently: managing portfolios of science and managing employees.

Science program management. Each PM is responsible for overseeing the portfolio of science under a research priority. Managing a portfolio of science involves stimulating and supporting innovative ideas for that priority topic, maintaining accountability, and balancing long-standing lines of research with new opportunities. PMs will mentor and provide research leadership opportunities to scientists within topical portfolios under each research priority; engage and communicate with station leadership,

partners, and colleagues in the WO; oversee research reporting such as CRIS/RITS; and ensure resources are sufficient and equitably allocated.

PMs will also act as a research initiative manager for the life of a research initiative. They will work closely with resource managers and scientists to generate ideas for research initiatives, identify relevant researchable questions, develop and lead integrated lines of research, and communicate results and applications. Other responsibilities include:

- Provide a multi-year perspective.
- Oversee progress and accomplishments (accountability).
- Engage partners (with assistance from the research initiative lead – see below).
- Connect scientists to research initiatives across the station.
- Connect subtopics within an initiative to tell a fuller story with interdisciplinary research.

Administration and supervision. Each PM will also manage 1-2 staff pools aligned by disciplinary core capacities including the following responsibilities:

- Provide programmatic and administrative supervision of a portion of scientists and support staff assigned to a core capacity homeroom.
- Build dynamic science capacity such that it can be leveraged as a cross-functional matrix.
- Provide technical supervision, administrative duties, and oversight for core capacity scientists.

Research initiative leads

In addition, each research initiative will have a **research initiative lead** – an established (GS 13-14) or senior scientist (GS 14-ST) who will provide science leadership in tandem with the program manager. These responsibilities will include:

- Visioning, collaboration, integration (scientific scope and inclusion).
- Partner engagement.
- Development of a problem analysis that defines the program of research within an initiative.
- Development of study plans for individual projects and studies within the initiative (R&D research planning requirements).
- Delivery and applications (outputs to outcomes).
- Participation and contribution to station science leadership.

Science advisory committee

Finally, we will convene a **science advisory committee** to provide oversight and guidance, to help the station assess whether we are meeting our goals, and to bring in a valuable science-focused perspective to our planning processes. Membership will be drawn from a variety of scientists, partners, and Forest Service Washington Office Program Leads. Some of the responsibilities of the advisory committee could include:

- **Engage** several times a year to check in. Gather informal feedback on station administrative operations, external partnerships, and overall station performance.
- **Annual or biannual review** of the research framework priorities and research initiatives with partners and scientists.

- **Charter review/revision.** Every 5 years, review charter with partners and scientists and possibly revise based on feedback. Review organizational alignment designed to achieve the goals of the research framework.

Core disciplinary expertise and lines of work

Our work continues to address some of the challenging problems facing society, including climate change, wildfire, clean water supply, community economic stability, human connections to nature, and endangered species. It is critical to maintain scientist capacity for important lines of basic and applied longer term work in addition to supporting the short-term research initiatives described above. Some of the knowledge we develop cannot be applied immediately but addresses long-term goals. Further, individuals and institutions can rarely foresee the pressing management and policy questions of the future, and chance often plays a big role in bringing specific research into management.

The expertise we cultivate in these core areas among our research scientists and professional/technical staff forms the framework that supports current and future science priorities and our research initiatives, as well as other partner collaborations, and foundational and long-term research (table 2).

The scientific knowledge cultivated by the station has yielded advances in forestry and rangeland science across the region and beyond. This knowledge spans a broad range of topics and includes new methods for quantifying carbon flux in terrestrial and aquatic ecosystems and identifying conservation priorities for northern spotted owls, amphibians, and endangered fish species. We have contributed new findings on invasive plants (Scotch broom, knotweed, ventenata), forest insects and diseases (*Armillaria* root disease, laminated root rot, mountain pine beetle), and threats to the subsistence resources relied on by American Indians and Alaska Natives. We study extreme fire behavior and have contributed field-ready tools to help fire managers forecast fire weather and smoke intrusions. Our work on salmon habitat recovery, the effects of riparian buffer management, and stream network modeling is shaping the way aquatic resources are managed in the Pacific Northwest.

These are just a few examples to illustrate how our basic and applied research has blazed new trails. Because 21st century environmental and social challenges are exceedingly complex, they require both strengthened disciplinary inquiry and broad interdisciplinary approaches. We design research initiatives to formalize and showcase our interdisciplinary partner-inclusive approach outlined in this charter. But we also need the disciplinary and multidisciplinary work that underlies our understanding of biological, ecological, and social complexity.

We use our disciplinary expertise to furnish material for the rapid development of research products or information to resolve short-term partner needs, ultimately enhancing our ability to respond to partner requests. While some lines of work do not follow the formal coproduction methodology of the research initiatives, this work is often developed in partnership with our information users on a smaller scale, and direction and formulation of relevant work are evaluated through annual reviews, checks and balances inherent in our funding allocation procedures, and feedback received during regular partner engagements.

Table 2—Core disciplinary expertise is maintained and applied to various problems and issues our partners and end-users face via our research initiatives and core lines of work.

Core Expertise	Knowledge Generated and Issues Addressed
Forest and Range Ecology and Management	Capacity in this broad arena allows us to conduct research related to the biophysical and social attributes and management of forest and rangeland ecosystems. Research outcomes increase our knowledge of ecological patterns and social processes at multiple scales in order to inform land management strategies to maintain, restore, and enhance ecological processes, ecosystem services, and forest and rangeland resilience in the face of climate change and other shifting disturbance regimes.
Wildlife Ecology	Scientists and staff bring expertise to understand the patterns, processes, and the management of wildlife, including ecologically, economically, and culturally important species, and rare and little-known species. With this knowledge we can better understand and manage species responses to climate change and other stressors, identify the role wildlife play in contributing to ecosystem resilience and sustainability, and provide information about species of management concern.
Fire, Fuels, and Smoke	Expertise in this area can be used to understand how wildland fire interacts with the biophysical and socioeconomic components of the landscape. Understanding of fire behavior processes, fire and climate interactions, predicting extreme fire weather, monitoring wildland fires, and anticipating the effects and interactions of fire on and with specific resources can be used to inform fire management, optimize active management, and mitigate and reduce wildfire risk.
Forest Monitoring and Assessment	Scientists and staff bring expertise to conduct fundamental and applied research to understand and predict changes in forested landscapes by conducting long-term inventory and monitoring of forest resources across all land ownerships within the Forest Inventory and Analysis framework. Work also includes the development of innovative methods and techniques for long-term monitoring, change detection and prediction of land stewardship and disturbance outcomes.
People, Natural Resources, and Economics	This capacity encompasses expertise about the human dimensions of land management, with relevance for regional economies, rural communities, and the traditional livelihoods of people across the West. Knowledge generated about human interactions with nature, government policies, and decision-making processes informs decisions and provide solutions that can have major impacts on issues such as jobs, urban design, forest products, collaborative governance, human health, wildfire risk reduction, and recreation.
Watershed and Aquatic Sciences	Expertise in this arena supports research designed to understand ecological and hydrological patterns and processes that characterize watersheds and aquatic-dependent ecosystems. Understanding the ecological and hydrological variability in aquatic ecosystems and the role climate change and other disturbances plays for native species is critical to developing watershed-scale assessment, approaches to riparian restoration, management strategies to improve resilience, and conservation of aquatic dependent flora and fauna.

Other station capacities

In addition to the scientific expertise of our researchers, our capacity includes unique assets that enable us to create a comprehensive “package” of science. These additional resources, assets, and programs are essential to the rest of the station and our ability to create holistic, integrated science in formats that fit our partners’ information needs. The combined resources and expertise of the Western Wildland Environmental Threat Assessment Center (WWETAC), the Northwest Climate Hub, experimental forests

and rangelands, and our Communication and Application group give the PNW Station substantial capacity to develop ambitious science that is empowered through effective delivery—boosting our potential to be a vital support to the Forest Service mission.

The Western Wildland Environmental Threat Assessment Center (WWETAC). Supported by three mission areas of the Forest Service (National Forest Systems, Research and Development, and State and Private Forestry), [WWETAC](#) was congressionally mandated in 2005 to provide natural resource managers with credible prediction, early detection, and quantitative assessment of environmental threats across the western United States. WWETAC offers unique expertise in integrated lines of work. Many well-known and widely adopted tools and modeling systems, such as ArcFuels, Landscape Treatment Designer, and ForWarn were developed at WWETAC. WWETAC products benefit many partners across the West, including federal, state, tribal, and private land managers; policymakers; landowners; communities; and federal, state, county, and community watershed and forest planners.

With its broad western regional focus, WWETAC is positioned to utilize capacity from across the three western research stations in service to the western Forest Service regions and other state, tribal, and nongovernmental entities. The current focus will be developing climate vulnerability assessments, the continued development of climate-driven dynamic vegetation models, and investigations to better inform forest and range ecosystem responses to climate-related stressors such as insect and disease outbreaks and drought.

Northwest Climate Hub: dedicated to partners. The [Northwest Climate Hub](#) is one of 10 regional hubs created in 2014 to develop and deliver science-based, region-specific, climate-smart information and technologies to agricultural and natural resource managers and provide them with access to assistance to implement those decisions. The Northwest Climate Hub serves Alaska, Idaho, Oregon, and Washington by conducting and translating research into information and technologies that farmers, ranchers, American Indian and Alaska Native tribes, natural resource managers, and forest landowners can use to adapt and adjust their resource management.

Headquartered at the PNW Research Station, the Northwest Climate Hub has staff in Olympia, Washington; Portland and Corvallis, Oregon; and Juneau, Alaska. The climate hub provides actionable information and technology to guide climate-informed decisionmaking to support sustainable working landscapes in the Northwest. They work with practitioners to codevelop science-based solutions to support sustainable and productive working landscapes in the Northwest in the face of climate change.

Continuous engagements with partners through the hub’s outreach efforts provide an effective feedback loop to ensure that the PNW Research Station’s core research is addressing the most challenging and relevant issues facing landowners and resource managers.

Together, we envision WWETAC and the Northwest Climate Hub to be the nexus for the delivery and application of social and biophysical science and decision support methodologies from across the western research stations.

Experimental forests and rangelands. Forest Service Research and Development is a relatively small research institution. But it has a competitive advantage that makes it unparalleled: the continental-scale network of more than 80 experimental forests and rangelands. This network offers a tremendous opportunity to serve as an observatory network for local regional-, and national- scale environmental and societal change.

The PNW Station administers 12 experimental forest and rangeland sites across Alaska, Washington, and Oregon ([fig. 1](#)). These living laboratories have allowed countless scientists and students to address complicated forest and rangeland management questions through manipulative experiments and long-term observations. For example, some of the landmark research from the H.J. Andrews Experimental Forest has more than once caused a rapid about-face in standard forest practices. Research on grazing at Starkey Experimental Forest and Range addresses how best to minimize impact to rangelands, which constitute a major portion of national forest lands. Many studies continue for decades, and these accumulated data make these sites extremely valuable for studying broad phenomena like climate change.

These sites also attract many federal, state and private research partners, including National Science Foundation's Long-Term Ecological Research program, the National Ecological Observatory Network, Smithsonian's Forest Global Earth Observatory, U.S. Geological Survey's experimental debris flume and others, all of which greatly increase the learning opportunities and leverage the station's investment in research at its experimental forests and range.

These sites, with their unique long-term research horizons, provide rare opportunities for stable research over time. They demonstrate the importance and singular role of government agencies in making a long-term commitment to maintaining dedicated sites for research and monitoring for the purpose of helping future generations solve outstanding issues in natural resource management.

Communications and Applications (CAP) group. Effective science communication requires translation and packaging information that is tailored to specific audiences. The CAP group plays a critical role in disseminating station science to users that include the National Forest System, state and other federal agencies, tribes, nongovernmental organizations, industry, private landowners, and other partners.

CAP creates awareness about station science and innovations through a variety means:

- Traditional publishing and distribution of scientific reports and periodicals written specifically for more general audiences
- Electronic distribution of scientific reports and periodicals
- National-level blogs
- Station website
- Social media
- Congressional briefings

Costs

The PNW Station uses congressionally appropriated funding (approximately \$45 million annually as of 2021) to meet research capacity requirements for personnel, facilities, and operations. Facilities and personnel salaries and expenses (S&E) are treated as fixed costs. The station's operating funds, approximately 15 to 20 percent of appropriations, directly support and generate coproduced priority research, research initiatives and foundational research.

The PNW-FIA is a congressionally mandated and funded program. Data are collected, managed, and analyzed from plots on multiple forest ownerships in Alaska, California, Hawaii, Oregon, Washington, and U.S.-affiliated Pacific Islands. The collection, analysis and management of this long-term data base

is housed within the Station Monitoring And Assessment program and widely available to the public. The PNW-FIA data are valuable for multiple lines of research throughout the station.

Maintenance and leasing costs for the station's 10 locations (Station Director's Office and 9 labs) and additional maintenance of developed facilities and infrastructure at 9 of 12 experimental forests ([fig. 1](#)) constitute approximately 12 percent of the station allocation. Personnel S&Es require approximately 70 percent of the total station budget. Combined, the station capacity in personnel and facilities consumes about 82 percent of station-appropriated funding.

The distribution of total station S&E is approximately 16 percent in administrative and communications staff and 53 percent in research staff. The congressionally mandated funds for PNW-FIA staff account for 31% of Station FRSE. Figure 3 (top panel) displays S&E distribution across the station by research staff, according to core disciplinary expertise ([table 2](#)) and other categories in fiscal year 2021.

Approximately 18 percent of station-appropriated funding is available for operational uses under the current station budgeting model, which is reflective of the initial implementation of coproduced research initiatives and this charter. The distribution of funds for operations is approximately 15 percent for administrative support, 3 percent for communications and 44 percent for research programs. The federally appropriated funds for PNW-FIA staff account for 38 percent of Station operational costs ([fig. 3 bottom left](#)).

An example of how the 44 percent of operational funds for research programs is broken out across core lines of work, research initiatives, experimental forests and long-term data streams for fiscal year 2021 is presented in the bottom right panel of figure 3. It is anticipated that as the station fully implements this charter, approximately 50 to 65 percent of operational research funds will be directed to coproduced research initiatives and 35 to 50 percent will be used to conduct core lines of work and long-term monitoring studies. This variability recognizes that for some research initiatives, core lines of work underway or long-term monitoring studies may be leveraged and folded into a higher profile initiative.

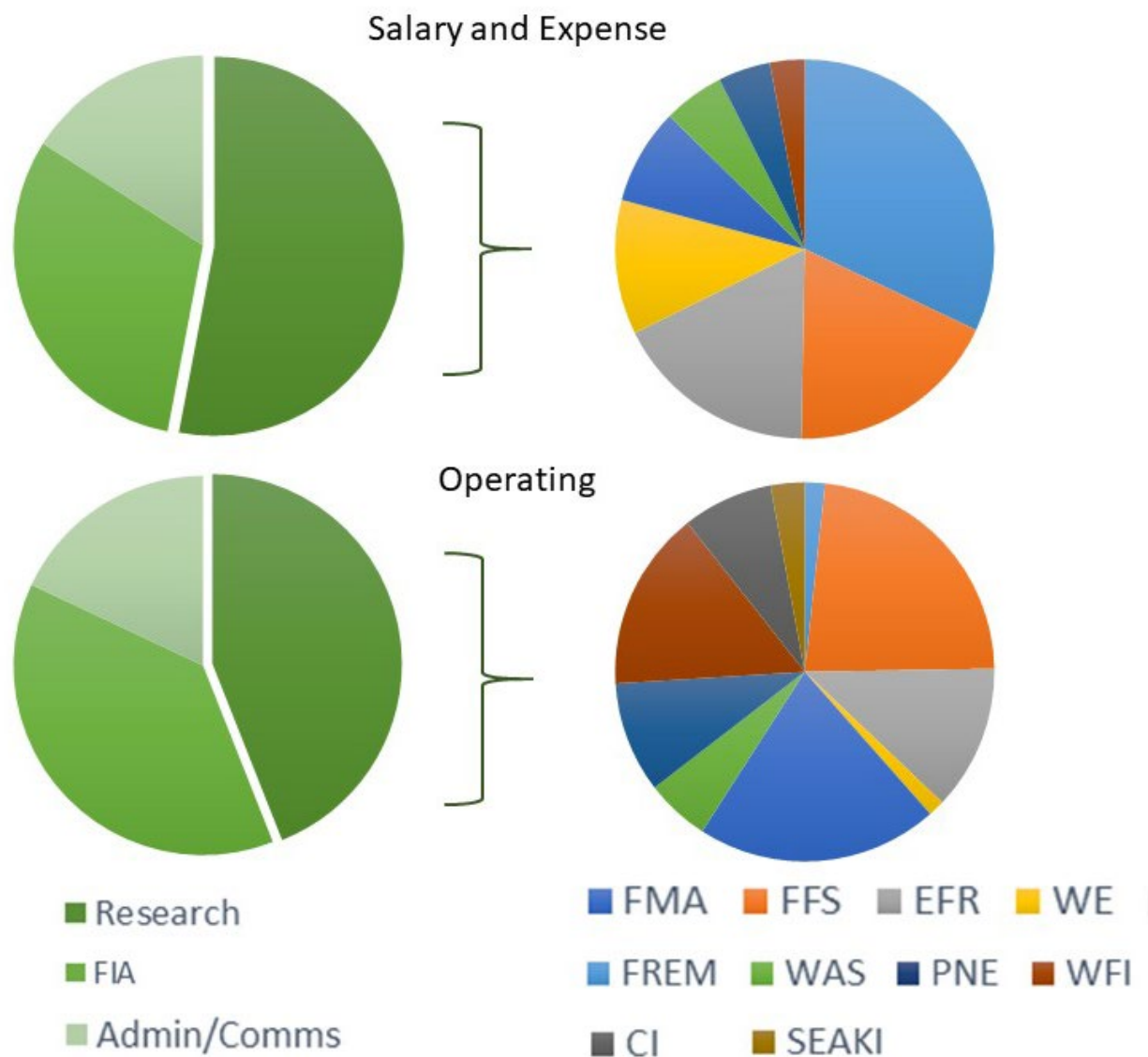


Figure 3—An example of station-wide (left) and research (right) cost distributions from fiscal year 2021. Top graphs: salary and expense; bottom graphs: operation funding. Research costs are broken out by core disciplinary expertise and lines of work as shown in Table 1, the three current research initiatives, and experimental forests and rangelands. Legend: FMA = Forest Monitoring and Assessment, FFS = Fire, Fuels and Smoke, EFR = experimental forests and rangelands, WE = wildlife ecology, FREM = forest and range ecology and management, WAS = watershed and aquatic sciences, PNE = people, natural resources, and economics, WFI = West-side Fire and Climate Adaptation Initiative, CI = Carbon Dynamics for Land and Watershed Managers Initiative, and SEAKI = Community Socioeconomic Well-Being and Resilience in Southeast Alaska Initiative.

Conclusions

With millions of people across the Pacific Northwest and Alaska living in close proximity to national forest land, it is imperative that we design research that recognizes people as integral to these ecosystems and that directly serves the information needs of our land management partners. Through our longstanding partnership with the National Forest System, we have achieved a capability to address natural resource challenges unmatched worldwide.

“The future of FS research is moving toward more adaptive management and socio-ecological systems and thinking more holistically about coproduction of knowledge.”

--Station scientist

By tethering this charter to partner engagement, we are implementing a responsive operational model that allows us to continuously adjust our lines of research according to the priorities of the agency and the needs of our management partners, even as we maintain a commitment to long-term basic and applied research. As we select topics for future research initiatives, we will ensure that new work we invest in supports our regional partners and is aligned with the Forest Service Research and Development priority areas.

Forest Service Research and Development has a responsibility to be out in front in developing knowledge and tools that address unanticipated issues as they emerge. This necessitates foundational long-term data collection as well as allowing scientists time to explore unresolved questions. The key is to maintain an appropriate balance between long-term foundational work and targeted work to address contemporary, well-defined information needs.

Our multifaceted approach allows us to supply “rapid response” science through our research initiatives while also continuing the long-term accrual of knowledge for the benefit of all. We are committed to our science mission and seek to empower all employees across the station to contribute to their fullest potential toward a unified goal: providing high-quality scientific information to help people understand and make informed choices about natural resource management and sustainability.

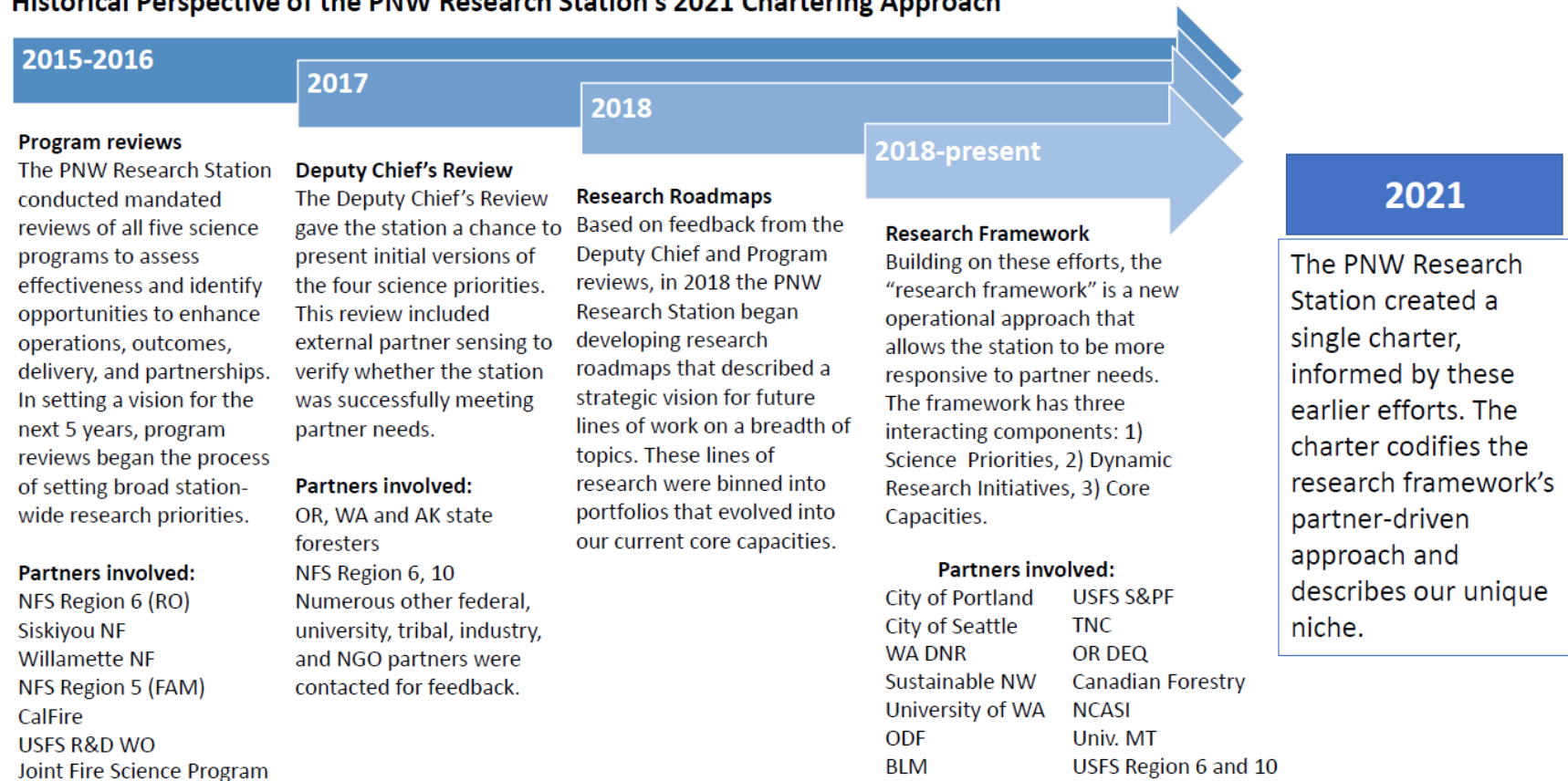
Acknowledgments

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Appendix

Historical Perspective of the PNW Research Station's 2021 Chartering Approach



This graphic illustrates formal scoping efforts and strategic visioning exercises throughout the past several years that cumulatively informed the development of our research priorities, selection of research initiative topics, and this charter.