2023 Annual Report

to the USDA Forest Service under Sponsor Award

#23-DG-11030000-013 for 2023 (NAU Projects 1005564, 1005570-1005574)

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Summary

This report presents an integrated and coordinated series of actions for $2.2 million awarded to the ERI in Fiscal Year 2023 under CFDA 10.694, Southwest Forest Health and Wildfire Prevention.

The information provided herein reflects our annual progress and comprises the final report for deliverables received under 23-DG-11030000-013 (NAU 1005564, 1005570-1005574).

All of the activities (deliverables) summarized in this report respond to land manager and stakeholder requests and needs. The deliverables are informed by best available science and scientific evidence, which is translated into the language and product appropriate for the target audience. The ERI actively delivers information using a variety of approaches, from individual and group presentations and discussions to printed and electronically accessible fact sheets, short technical reports, longer white papers and management reports, and peer-reviewed archival literature.

The Ecological Restoration Institute at Northern Arizona University is grateful for the funding that the United States Department of Agriculture Forest Service has provided for these efforts.

FY23 Deliverables (Final) – #23-DG-11030000-013

FY23 Deliverables, Final – #23-DG-11030000-013

Focal Area 1. Restoration and Climate Adaptation Knowledge Development and Transfer

1.1 Long-term monitoring.

This work fulfills several ERI strategic goals and land management priorities related to analysis of landscape processes and climate change effects in forest ecosystems and continues FY21 and FY22 work to provide new information on understudied ecosystems. The overarching aim of this multi-year effort is to assist managers in planning for climate change and landscape-scale restoration. Information from Project 1.1a will also help managers identify goals for managing a wilderness landscape that is of major importance to Flagstaff and local tribes. In FY23, we will remeasure additional long-term monitoring plots to analyze tree mortality and changes in composition of higher elevation forest types. In Project 1.1b, we will return to sample plots established to monitor long-term dynamics of a local endemic plant species, Sunset Crater penstemon (*Penstemon clutei*). This work will provide information to local managers regarding the impact of the 2022 Pipeline and Tunnel fires on the viability of an important, rare species.

1.1a: <u>Deliverable</u>: San Francisco Peaks ecosystem monitoring. Technical report on results from data analysis.

Stoddard, M.T., K.C. Rodman, C.D. Crouch, D.W. Huffman, P.Z. Fule, K.M. Waring, and M.M. Moore. 2024. [Multi-decadal aspen dynamics show recruitment bottleneck across complex mountain community](). *Forest Ecology and Management*, 572: 122326.

1.1b: <u>Deliverable</u>: Sunset Crater penstemon monitoring. Technical report on results from data analysis.

Springer, J.D., D.W. Huffman, K.A. Sena, E. Schaefer, J.E. Crouse, P.Z. Fule. 2024. [Landscape Monitoring of Sunset Crater Beardtongue (*Penstemon clutei*) Including Wildfire Effects, Sunset Crater National Monument and Coconino National Forest, AZ](). Technical Report. Ecological Restoration Institute, Northern Arizona University. 22 p.

1.2 Pinyon-juniper stand dynamics and treatment responses.

The ERI has identified pinyon-juniper as an understudied ecosystem. Project 1.2a will revisit monitoring plots established by Forest Health Protection scientists in 2004 after an extensive mortality event that resulted from drought and severe bark beetle outbreak. This work seeks to better understand bark beetle-related mortality in pinyon pine and the importance of stand density and site conditions. Project 1.2b is an ongoing effort and an additional cooperative project being conducted with Forest Service Forest Health Protection (FHP) NM Zone Lead Andy Graves. In this project, the ERI will collect field data on understory plant community characteristics after hazardous fuels reduction and slash treatments and may entail assisting with analysis of other data collected by the New Mexico Forest and Watershed Restoration Institute or other entities. Results from this study will help managers better anticipate understory responses associated with various slash disposal alternatives.

1.2a: Bark-beetle-driven pinyon pine mortality in Arizona and New Mexico.

1.2a.i: Deliverable: Dataset for analysis.

The dataset for analysis is included in the progress report below detailing findings from this study.

1.2a.ii: Deliverable: Summary report on findings.

Huffman, D.W., and R. Pedersen. 2024. Bark-Beetle-Driven Pinyon Pine Mortality in Arizona and New Mexico. Progress Report. Ecological Restoration Institute, Northern Arizona University. 4 p.

1.2b: Deliverable: Long-term changes in pinyon-juniper structure and regeneration. Presentation for managers and/or interested stakeholders.

For this deliverable, ERI research staff recognized a need for a larger workshop on pinyon-juniper woodlands that will share results from this work. The workshop is being planning for FY24.

1.2c: Deliverable: Mt. Taylor (NM) pinyon-juniper thinning and slash treatments. Progress report.

Huffman, D.W., and M.T. Stoddard. 2024. Understory Responses to Pinyon-Juniper Fuels Reduction and Slash Treatments. Progress Report. Ecological Restoration Institute, Northern Arizona University. 2 p.

1.3 Mount Trumbull Wilderness fire outcomes.

In this study, we propose to quantify structural attributes at fine-, mid-, and landscape-scales for two OTFS wildfires that occurred in the mid-2000s in the Mount Trumbull Wilderness in Grand Canyon-Parashant National Monument. Using an array of long-term monitoring plots established before the fires, we will analyze structural outcomes and compare present conditions to baseline stand reconstructions of the pre-fire-exclusion period (ca 1880). We will use complementary methods of field sampling, spatial interpolation, and remote sensing data to analyze attributes across scales. Results from this work will provide new information concerning the effectiveness of managed wildfires to meet restoration goals in frequent-fire forests. Information gained in this study will be valuable and timely for land managers needing to meet landscape-level fuels reduction and restoration objectives.

1.3a: Deliverable: Technical report on field data examining ecological responses to managed wildfire.

Technical Report
Roccaforte, J.P., **D.W. Huffman**, **K.C. Rodman**, T.A. Heinlein, **J.E. Crouse**, and P.Z. Fulé. 2024. [Resource objective wildfires shifted forest structure toward historical conditions in a remote Arizona Wilderness](). ERI Technical Report. Ecological Restoration Institute, Northern Arizona University. 27 p.

Presentation
Roccaforte, J.P., **D.W. Huffman**, **K.C. Rodman**, T.A. Heinlein, **J.E. Crouse**, P.Z. Fulé. Resource objective wildfires shifted forest structure towards historical conditions in a remote Arizona Wilderness. 4th Southwest Fire Ecology Conference, Santa Fe, NM. November 19, 2024. 60 participants.

1.4 Human dimensions of managed wildfires.

We recently completed a white paper that reviewed policies related to managing wildfires for resource benefit, also known as managing wildfires for other than full suppression strategies (OTFS). Following lessons learned from the policy review, we are continuing to explore how managers interpret policy and guidance for wildfires managed for OTFS, what tools and resources managers use to inform decisions, and how this varies across jurisdictional entities and landscapes in coordination with the other SWERI. This will allow us to better assess the impacts of policy on decision making, and ultimately, provide important information about how decision-making factors influence the ecological outcomes of wildfires managed for OTFS. Because wildfire decision making is guided by policy but interpreted differently by managers across different jurisdictional entities and landscapes with different decision contexts, we surmise that the ecological outcomes of wildfires reflect how policy, acceptable levels of risk, and other decision factors are interpreted by managers on the ground, and additional work with these managers will allow us to better validate this line of thinking.

1.4a: Deliverable: Report (maybe publication) on open-ended interviews with managers.

Journal Article
Franz, S.T., **M.M. Colavito**, and C.M. Edgeley. 2024. [From flexibility to feasibility: Identifying the policy conditions that support the management of wildfire for objectives other than full suppression](). *International Journal of Wildland Fire,* 33, WF24031.

Fact Sheet
Franz, S.T., **M.M. Colavito**, and C.M. Edgeley. 2024. [Flexibility to Feasibility: Identifying Policy Conditions that Support Managing Wildfire for Objectives Other than Full Suppression](). ERI Fact Sheet. Ecological Restoration Institute, Northern Arizona University. 2 p.

1.5 Wilderness management.

This project would explore wilderness management from both a social and ecological perspective, focusing on the Kachina Peaks Wilderness in northern Arizona, and consist of a policy and literature review on active forest management in designated wilderness areas (including but not limited to forest thinning, prescribed fire, cultural burning, and managing fire for resource objectives), contextualizing local ecological data within this policy landscape, and initiating the scoping of a broader study on the perceptions of both land managers and the nearby public on active wilderness management. This responds to local interest expressed by the City of Flagstaff, Coconino County, and Forest Service partners who have recognized the potential threat of uncharacteristic fire in wilderness, yet are not clear on how to manage forests in the Kachina Peaks Wilderness. The extensive ecological data collected over decades by the ERI within this wilderness provides a unique opportunity to combine a policy analysis with a robust long-term ecological dataset to illustrate how manager decisions to intervene or not have shaped the ecological characteristics of this wilderness.

1.5a: Deliverable: Report on policy and literature review, case study design.

Scoping report is enclosed here.

1.6 Reforestation after wildfire.

In FY23, we will begin working with local managers to evaluate successes of past efforts to replant and seed sites after severe wildfire. We will also initiate a policy and literature review on the human dimensions of reforestation in the western US affecting public and tribal lands. Field surveys and on-site visits of reforestation success will begin in summer 2023 and culminate in FY24 with a large extent analysis using remote sensing data. We also will compile relevant literature and policies, legislation, regulations, and guidelines to analyze how they shape the current potential for reforestation in the US. We will conduct open-ended interviews with managers who work for or with federal land agencies on reforestation to better understand what factors shape reforestation and ensure we are reviewing the appropriate policies affecting their work. Once this foundation is laid, we will expand this study in the next fiscal year to include more interviews with or a survey of key actors in western US reforestation.

1.6a: Deliverable: Reforestation policy analysis. Report that identifies how policies and regulations are influencing reforestation in the US West, examines the current state of social science research on reforestation on US public and tribal lands, and identified research gaps in this rapidly changing environment.

Scoping report is enclosed here.

1.6b: Deliverable: Ecological drivers of reforestation success. Report on progress and remote sensing design.

Rodman, K.C., P.J. Fornwalt, Z.A. Holden, **J.E. Crouse**, K.T. Davis, L.A.E. Marshall, **M.T. Stoddard**, R.A. Andrus, M.E. Chambers, T.B. Chapman, S.J. Hart, C.A. Schloegel, C.S. Stevens-Rumann. 2024. Green is the New Black: Outcomes of post-fire tree planting across the US Interior West. *Forest Ecology and Management*, 574:122358.

1.7 Systemic review and science summary.

Work in FY23 will leverage systematic reviews and summaries funded by alternative sources. Assistance to leverage externally funded "fuel-treatment effectiveness" systematic review, with SWERI partners.

1.7a: <u>Deliverable</u>: Report on progress.

ERI research staff participated in the following published fuel treatment effects study with SWERI partners:

Vorster, A.G., C. Stevens-Rumann, N. Young, B. Woodward, C. Tsz Hin Choi, M.E. Chambers, A.S. Cheng, M. Caggiano, C. Schultz, M. Thompson, M. Greiner, G. Aplet, R.N. Addington, M.A. Battaglia, D. Bowker, E. Bucholz, B. Buma, P. Evangelista, **D.W. Huffman**, S. Mueller, C. Rhoades, W.H. Romme, **A.J. Sánchez Meador**, W.T. Tinkham, M. Tuten, and A. West Fordham. 2024. [Metrics and Considerations for Evaluating How Forest Treatments Alter Wildfire Behavior and Effects](#). *Journal of Forestry*, 122: 13–30.

1.8 Fire history analysis.

Building on work completed in FY22, we will collaborate with Dr. Chris Guiterman (University of Colorado at Boulder) to initiate a multi-century reconstruction of area burned by analyzing fire scars recorded in tree rings in frequent-fire forests across Arizona and New Mexico. Area burned reconstructions have been done for sites and small landscapes, but never at a regional scale. Results from this multi-year study will aid managers in regional wildfire and forest restoration planning. In FY23, we will collect fire scars at new fire history sites that fill spatial gaps identified in [the North American Tree-Ring Fire Scar Network](#) of sites in Arizona and New Mexico. With these new data, we will calibrate the fire-scar network to modern area burned and conduct an empirical reconstruction of fire activity back through time.

1.8a: <u>Deliverable</u>: Progress report on data collection and initial analysis.

Guiterman, C.H., E.Q. Margolis, **D.W. Huffman**, and M.K. Lonergan. 2024. [The size of a modern "megafire" is not unprecedented when viewed in a multi-century context](#). ERI Technical Report. Ecological Restoration Institute, Northern Arizona University. 19 p.

Focal Area 2. Apply ERI Expertise to Restoration Implementation at Appropriate Scales

2.1 Expanding the capacity of forest operations and biomass utilization.

This ERI program area is to expand industrial capacity and markets to utilize small-diameter wood and biomass. These projects are mostly supported by a mix of external grants and state funding. The federal work plan will support this broad program with administrative support, public relations, and outreach, in three key project areas, which include:

a) The development of the Forest Operations Training Program (FOTP) was initially supported by an external grant (US Economic Development Administration). As a final step for the implementation of FOTP, we will develop a cash flow model that can be used to assess the financial sustainability of running the FOTP for the next 20 years in partnership with Coconino County and local community colleges. The team will perform break-even and sensitivity analysis using the model to evaluate financial risks associated with high-cost items and discontinued incomes.

b) ERI staff recently published a journal article summarizing thinning costs throughout the western US over the last 40 years (1980–2020). As a follow up, the ERI team is developing a spreadsheet-based model for users to quickly estimate thinning costs by entering key variables in thinning prescriptions and operations. Workshops demonstrating the model will be offered for forestland managers and logging contractors. This project is funded by the state and the Forest Service's Rocky Mountain Research Station.

c) The NAU–ERI team has been conducting a field-based experiment to test a mobile operation of CharBoss to convert woody biomass materials into biochar. The team will expand the research to broaden our knowledge on the benefits of biochar in improving the soil properties and enhancing plant growth in sodic/saline soils with additional funding provided by a USDA Forest Service's Rocky Mountain Research Station.

2.1a: <u>Deliverable</u>: Report and a fact sheet of the FOTP financial sustainability analysis.

The primary goal of the FOTP is to train new forest operations professionals including forest machine operators, truck drivers, and heavy equipment repair and maintenance specialists who carry out forest restoration treatment operations. Three Arizona counties (Coconino, Navajo, and Apache) and three community colleges (Northland Pioneer, Coconino, and Yavapai) have joined the FOTP regional workforce training system along with many other key community-based, education, government, and industry partners.

The ERI team, including key collaborators, published two research articles explaining the effectiveness of simulators to train new forest operation workers and developed a spreadsheet-based model to assess long-term (>20 years) financial feasibility of running the FOTP. Those articles and the model along with the final report are available to download from the ERI [website](#). The model is flexible enough for users to tailor it to reflect their own specific training programs and administration logistics. The FOTP workforce development team is now ready to offer training courses and focuses on securing initial funding from competitive grants and government agencies at both federal and state levels.

i. Bilek, E.M., and **H.-S. Han**. 2024. [Modeling Financial Sustainability in a Forest Operations Training Program](#). ERI Technical Report. Ecological Restoration Institute, Northern Arizona University. 84 p.

ii. Burk, E. **H.-S. Han**, M. Smidt, and B. Fox. 2024. [Incorporating simulators into a training curriculum for forestry equipment operators: A literature review](#). *Croatian Journal of Forest Engineering*, 45(2024)1. p199-215.

2.1b: <u>Deliverable</u>: A spreadsheet-based model, which will be available on the ERI website, and two to three (2–3) subsequent workshops.

ThinCost 1.0: A spreadsheet-based model to estimate thinning costs

Forest restoration in the Southwest requires the removal of small-diameter and low-value timber, for which harvesting and transportation costs are often greater than the value of the logs and biomass materials removed. To adequately plan for harvesting operations, land managers must have a thorough understanding of the costs involved, what factors are influential in determining these costs, and how they vary by harvesting systems.

The ERI team developed a spreadsheet-based model (ThinCost 1.0), offered workshops, and gave oral presentations to help people learn how to use the model. For example, we offered one full-day workshop to explain how to use the model when assessing an economic feasibility of their thinning contracts in June 2024, which was part of a two-week long training program (Logging and Road Institute) for 35 Forest Service foresters. The model is available to download [here](#).

2.1c: <u>Deliverable</u>: Journal publication summarizing biochar benefits in ecological restoration.

Air Curtain Burner and CharBoss Study

Air Curtain Burner (ACB) and CharBoss (CB) machines were developed to offer an alternative to open pile burning that produces fewer smoke emissions, long term damage to forest soils, and danger of uncontrolled wildfire. This study evaluated the performance of ACB for biomass disposal and CB for biochar production with the objective of quantifying the benefits and limitations of each machine. The research article below summarizes the study results.

Oyier, P.O., **H.-S. Han**, **D. Ghosh**, N. Anderson, D.S. Page-Dumroese, D.W. McCollum, J.M. Tirocke, D.N. Pierson. 2024. [FireBox and CharBoss: An alternative to open burning of woody biomass](). *Biomass and Bioenergy*, 190: 107364.

2.2 Facilitate the development and integration of new technologies to advance restoration implementation.

In FY23, the ERI continues to add capacity to the development of a Digital Timber Sale Manager (DTSM) pilot. The DTSM is a digital system that manages spatial data for the life of a timber sale to improve efficiency in restoration implementation. It will be used in the Four Forest Restoration Initiative (4FRI) project in partnership with The Nature Conservancy and Forest Service, including the FPM team. In FY23, the ERI will continue convening and facilitating the development of the DTSM pilot, as well as capturing and communicating the lessons learned from the pilot that may serve as a guide for the integration of new technologies in Forest Service implementation processes beyond the 4FRI area.

2.2a: <u>Deliverable</u>: Progress report.

Colavito, M.M. 2024. [Four Forest Restoration Initiative Digital Timber Sale Manager Pilot Project: FY23 Progress Report from the Ecological Restoration Institute](). Progress Report. Ecological Restoration Institute, Northern Arizona University. 12 p.

Focal Area 3. Foster and Support Partnerships

3.1 Support and science delivery for the 4FRI collaborative project.

The ERI has provided leadership, administration, and science support to the 4FRI collaborative project since the 2009 request for proposals. Now a Wildfire Crisis Strategy National Priority Landscape, 4FRI is working to optimize NEPA-approved treatments across the multi-million-acre landscape. The ERI is committed to continued collaboration in the multi-stakeholder partnership to realize landscape resiliency and restoration.

3.1a: <u>Deliverable</u>: Report on leadership activities and work group technical support for the 4FRI Stakeholder Group and working groups.

M. Colavito – Co-chair of 4FRI Stakeholder Group and Steering Committee leader, July 2023 – June 2024.
M. Colavito – Co-chair of 4FRI Implementation Working Group, August 2023 – January 2024.
A. Waltz – Co-chair of the 4FRI Treatment Prioritization and Optimization Group, July 2023 – ongoing.
T. Dubay – Chair of Communications Group, July 2023 – ongoing.

3.1b: <u>Deliverable</u>: 4FRI Landscape Treatment Prioritization–Optimization Work Group: Workshop and a report on progress.

The 4FRI Treatment Prioritization-Optimization working group worked with USDA Forest Service 4FRI Leadership and Stakeholders to build consensus and buy-in across 4 meetings, and 3 mini workshops.

7/24/23 – 8/9/24:

- Working Group methods discussions: PODS, IFTDSS, and QWRA methodology with 4FRI Fire and Fuels staff, USDA Forest Service Enterprise Team, R3 Fire Analyst.
- 4FRI Executive Board and Leadership meeting to seek clarity on participation and outcomes.
- Synthesis of WCS Values at Risk, with 4FRI SHG values at risk. Workshop designed to capture SH questions and information needs about revised values at risk.
- Working group workshop to review values at risk: 3 values reviewed; 7 planned for next reporting period, with full SHG Workshop.

3.1c: <u>Deliverable</u>: Report on administrative support to facilitate effective collaborative operations; and IT support for the 4FRI website and BASECAMP; and administrative support.

H. Norton – July 2023–ongoing. Maintains all website support. (See Focal Area 6.2a for web analytics.)

3.2 Kaibab National Forest Burnt Corral.

The ERI will provide steering committee support, forest ecology science support for collaborative issues, including old growth identification and management, and provide technical optimization work.

3.2a: <u>Deliverable</u>: Report on activities.

ERI staff contributed to Burnt Corral Collaborative progress through assistance to facilitators in planning and meeting development, participation in two field trips and two partnership meetings, and additional attendance of a technical data sub-group. The Collaborative has moved forward on defining broad areas of consensus, including shared "undesirable outcome." In addition, work was done to quantify undesirable outcomes in the more recent fires on the N. Kaibab, and correlate those to the pre-existing forest conditions. Field trips are trying to locate the areas where fuels goals may overlap with old-growth forest structure; but have better elucidated where there are high zones of agreement to work, around old-growth, and within old-growth (but not to old-trees). Technical work extended into the next fiscal year, with outputs to be reported in FY24 documentation.

3.3 Socio-economic monitoring and science delivery for the USDA Collaborative Forest Landscape Restoration Program.

In FY23, the ERI, in coordination with the other SWERI and the Forest Service CFLRP coordinator, will continue to expand the implementation of a core socio-economic monitoring indicator for CFLRP projects. The SWERI are working to inventory and document information pertaining to the collaborative function, health, governance, and resilience of CFLRP projects. In FY21, a core social monitoring indicator was piloted on the Northern Blues CFLRP, and in FY22, this indicator (questionnaire) was expanded to all 15 of the newly funded CFLRPs throughout the country in coordination with the CFLRP leaders, regional coordinators, and CFLRP participants. In FY23, the SWERI will synthesize results across all projects to generate a national-level report, as well as initiate in-depth case studies in 3–5 CFLRP projects starting in FY23. We will utilize open-ended interviews to add context to findings. The SWERIs are co-developing this monitoring indicator with the Forest Service WO to ensure that the information collected by SWERI supplements the national core CFLRP monitoring requirements. The SWERI will work with CFLRP collaborators to disseminate learning about collaborative resilience to the newly funded CFLRP projects, the Forest Service WO and regional coordinators, and Congress to provide information about the social outcomes of the CFLRP.

3.3a: Deliverable: Technical report synthesizing findings to the Forest Service and Congress.

Technical Report

Beeton, T.A., H. O'Reilly, **N. vonHedemann**, **M.M. Colavito**, T. Teel, C. Huayhuaca, T.L. Teel, A. Snitker, and A. Cheng. 2024. Collaborative Forest Landscape Restoration Program (CFLRP) Collaborative Governance Assessment Report: A National Baseline Synthesis for the Common Monitoring Strategy. SWERI Technical Report. Southwest Ecological Restoration Institutes.

Briefing Paper

Beeton, T.A., H. O'Reilly, **N. vonHedemann**, **M.M. Colavito**, T. Teel, C. Huayhuaca, T.L. Teel, A. Snitker, and A. Cheng. 2024. Collaborative Forest Landscape Restoration Program (CFLRP) collaborative governance assessment: Summary of findings for the Common Monitoring Strategy. SWERI Briefing Paper. Southwest Ecological Restoration Institutes.

3.3b: Deliverable: Annual progress and accomplishments report.

Colavito, M.M. 2024. Collaborative Governance Monitoring for the Collaborative Forest Landscape Restoration Program: FY23 Progress Report from the Southwest Ecological Restoration Institutes. Progress Report. Southwest Ecological Restoration Institutes. 9 p.

3.3c: Deliverable: Coordinate and/or participate in one to two (1–2) peer learning activities or conference.

Colavito, M.M., **N. vonHedemann**, H. O'Reilly, T. Beeton, C. Huayhuaca-Frye, A. Snitker, T. Teel, and T. Cheng. Collaborative Forest Landscape Restoration Program (CFLRP): Exploring Collaborative Health, Resilience, and Governance. National Forest Foundation. April 24, 2024. 44 participants.

3.4 Risk Management Assistance (RMA) and Potential Operational Delineations (PODs) evaluation.

In FY23, in collaboration with the other SWERI, RMRS researchers, the Forest Service RMA team, and other researchers, the ERI will continue to conduct applied social science to assist in evaluating the use and effectiveness of RMA and PODs to advance the science and practice of decision support tool use for wildfire response, as well as pre-fire planning and post-fire recovery. This will involve a range of approaches, including follow-up assessments on the use of RMA/PODs, case studies of tool use in different contexts, and evaluating the use of these tools in Wildfire Crisis Strategy landscapes. This is a multi-year, ongoing project in coordination with partners across SWERI and the Forest Service.

3.4a: Deliverable: Annual progress and accomplishments report.

In FY23, ERI continued to collaborate with the other SWERI, RMRS researchers, and Forest Service staff working on RMA to evaluate decision support tool use in wildfire response. Progress on this work in FY23 resulted in the following completed actions:

- First, a draft manuscript that summarized findings from a survey of 2021 wildfires and case studies with two 2022 wildfires was prepared and submitted to the journal *Fire Ecology* for review.
- Second, analysis of interview data with leadership from the Forest Service about perceptions of RMA was analyzed and a draft manuscript summarizing the findings was initiated.
- Third, because of requests from partners, this work expanded into an assessment of the Incident Strategic Alignment Process (ISAP) during wildfire incidents. ISAP is an emergent platform and process that builds from, and directly uses, the spatial strategic planning framework and risk-informed analytical tools (i.e., RMA) to inform strategic decision-making.

To that end, the ERI and SWERI team has expanded this into a multi-year project to better understand strategic wildland fire management and began conducting case studies and participant observation to examine the use of ISAP and provide recommendations to improve risk-based, structured decision-making processes on wildfires. This research is an extension of previous surveys, case studies, and interviews to explore strategic risk-informed decision-making on wildfires, including the use of decision support tools like the Risk Management Assistance (RMA) platform and Potential Operational Delineations (PODs). In FY23, the SWERI team observed the adoption of ISAP and RMA on incidents and specifically, explored Agency Administrator (AA) perspectives on the use of analytical tools and frameworks. The team also conducted interviews with AAs to understand their perspectives of ISAP. This work will continue in FY24.

3.4b: Deliverable: Peer-reviewed manuscript or technical report synthesizing findings.

- Beeton, T., T. Aldworth, **M.M. Colavito**, **N. vonHedemann**, C. Huayhuaca, and M. Caggiano. *In Review.* The diffusion of Risk Management Assistance for wildland fire management in the United States. *Fire Ecology*.

- Beeton, T. and **M.M. Colavito**. Understanding and Applying Wildfire Risk Science and Decision Support Tools. SWERI Briefing Paper. March 2024.

3.4c: Deliverable: Coordinate and/or participate in one to two (1–2) peer learning activities.

Colavito, M.M., T. Beeton, T. Aldworth, **N. vonHedemann**, C. Huayhuaca, **S. Franz**, M. Caggiano. *Assessing the Risk Management Assistance Dashboard Use in Wildfire Response.* Association for Fire Ecology Fire Congress. Monterey, CA. Dec. 6, 2023.

3.5 Support for Wildfire Crisis Strategy.

The ERI will assist in creating greater state capacity to reduce wildfire fuels around our communities, making greater use of partner capacity to reduce wildfire fuels, and increasing partnerships to reduce wildfire risks on federal lands neighboring our communities. In addition, the ERI partners with the DFFM Northern District and local municipal fire stations.

3.5a: Deliverable: Report on support to the Wildfire Crisis Strategy federal and state partners.

ERI support to the WCS has largely been through the treatment-prioritization work on the 4FRI landscape (see 3.1.b, above). The ERI has worked closely with the R3 Fire Analyst to ensure there is consistency in 4FRI desired prioritization outcomes, with the WCS prioritization requirements.

3.6 SWERI partnership and across-region science delivery.

The three SWERI are uniquely positioned to synthesize and share science outreach and delivery. Currently, the SWERI coordinate to leverage monitoring knowledge and to realize cross-region biomass utilization grant outcomes. Following the Cross-Boundary Landscape Restoration Workshop in May 2023, the SWERI will produce a workshop summary and identify high-leverage project areas for the FY24 Work Plan.

3.6a: Deliverable: Report on support.

The ERI, with the other two SWERI institutes, completed the cross-boundary workshop summary report. Draft report enclosed here.

Video summaries and workshop briefs were shared via the SWERI website. And small video shorts were released via the SWERI YouTube channel and two social media releases.

Project 4. Integration and Engagement with Tribal Land Restoration

4.1 Wood for Life project.

The ERI will continue to work in partnership with the National Forest Foundation, The Nature Conservancy, the Forest Service, and tribal partners to evaluate needs and assess capabilities to formalize and sustain the Wood for Life program. Wood for Life is a tribal fuelwood program that utilizes biomass produced from restoration projects in the 4FRI and Flagstaff Watershed Protection Project footprints. The ERI will support Wood for Life capacity needs (e.g., grant proposals, communication briefs, after action reviews, etc.) to increase sustainability of the project, as well as help to review and evaluate existing program efforts to inform learning and future processes.

4.1a: Deliverable: Report on progress.

The ERI has been a key participant in the Wood for Life partnership, which is working toward three main goals: 1) providing resources and a sustainable source of firewood to local tribes through restoration efforts; 2) reducing forest-wide fuels; and 3) fostering and strengthening partner relationships.

The ERI engagement in WFL consists of several activities: 1) designing, completing, and socializing the needs assessment (see 4.1c); 2) scheduling, attending, and supporting meetings and events to facilitate the growth and needs of the partnership; 3) facilitating meetings as a rotating chair (see 4.1d); and 4) updating the partnership statement. The ERI sends out the existing partnership statement to WFL participants and asking for feedback on updating contact information on which partners are currently engaged and who the best points of contact are. The ERI then updates this information in the partnership statement and distributes the new version on an approximately quarterly basis.

The ERI set up a series of quarterly meetings starting in 2023 with our sister institute, NMFWRI, to coordinate across the SWERI on WFL efforts in the Southwest.

4.1b: Deliverable: One to two (1–2) presentations to and with partners on Wood for Life.

- Met with NFF partners in other regions (ID and MT) to discuss the needs assessment process. Aug. 3, 2023.
- Participated in the WFL Cross-Regional Site Visited organized by NFF. Provided handouts and a short presentation on the needs assessment progress. Received recognition for contributing to WFL receiving the 2022 Chief's Award. Sept. 27–28, 2023.
- Graduate student Aidan Franko, working with the ERI, presented her master's professional paper to NAU's School of Forestry weekly seminar series. ERI staff Jon Martin and Niki vonHedemann served as readers for her paper to support her degree completion. March 27, 2024.
- N. vonHedemann presented about professional opportunities to Hopi nonprofit Pikyanivi Wood Haulers. May 15, 2024.

4.1c: Deliverable: Needs assessment to estimate amount of firewood necessary for "vulnerable and needy" residents using US census data and supplemental community-level questionnaires.

See enclosed progress report for details on this deliverable.

4.1d: <u>Deliverable</u>: Proposed TFPA agreement between tribal entity and the Forest Service to support Wood for Life.

See [enclosed](#) project report for details on this deliverable.

4.1e: <u>Deliverable</u>: Facilitation for Wood for Life meetings (rotating chair duties).

The ERI participates in monthly WFL meetings by acting as the rotating chair. In FY23, N. vonHedemann rotated with other partners at taking notes and facilitating the monthly WFL meetings. These meetings are online and are open for participation for anyone participating in WFL. Frequent participants include timber staff and tribal liaisons from the Coconino and Kaibab national forests, the National Forest Foundation, the ERI, Ancestral Lands Conservation Corps, other tribal nonprofits such as Koho for Hopi or Pikyanivi Wood Haulers, and representatives from Hopi villages and Navajo chapters.

4.2 Tribal Forest Protection Act (TFPA)/ 638 authorities and cross-boundary pilot projects.

ERI will assist tribal partners in scoping cross-boundary opportunities for forest, woodland, and fire management with Arizona tribal entities.

4.2a: <u>Deliverable</u>: Report on federal-level and tribal programs' use of TFPA agreements to advance cross-boundary collaboration.

Several uses of TFPA agreements are now in place with Arizona tribal entities to support cross-boundary tribal engagement. The most notable is the San Carlos agreement with the Tonto National Forest's Globe Ranger District. Years of effort to formalize this agreement has resulted in San Carlos being identified as a national priority landscape in the Wildfire Crisis Strategy. The area within the landscape includes tribal ancestral lands, Forest Service land, and a mixture of other jurisdictions. It allows the San Carlos tribe to protect resources on reservation lands and to pursue co-management options of cultural significant lands and resources outside of their reservation. Project-level TFPA agreements are also in place to support tribal engagement in the management of cultural significant sites on the Coronado National Forest.

Presentations regarding the use of TFPA and 638 agreements at the Arizona Tribal Fire and Climate Resilience workshop, held at San Carlos, received limited response. Several recommendations in the Wildfire Crisis Management and Mitigations Commission's report to Congress include the use of agreements with tribes to increase engagement and integration of tribal practices to address the wildland fire crisis. Once again, the San Carlos tribe is the primary Arizona tribal entity has pursued landscape scale treatments using TFPA.

4.3 Engage with tribal partners to identify and exchange existing ecological questions or gaps.

The ERI has initiated partnerships with the San Carlos Apache and Hualapai tribal nations and will expand those partnerships to exchange restoration information and develop a science needs assessment. The ERI tribal program works with the ERI's ecology and human dimensions programs to realize opportunities for research and partnerships.

4.3a: <u>Deliverable</u>: Needs assessment of restoration science partnership opportunities.

See [enclosed](#) needs assessment report for details on this deliverable.

4.4 Tribes and post-fire governance.

This project leverages funding provided by the Southwest Climate Adaptation Science Center (SW CASC) to examine several questions in the southwestern states of Arizona, Utah, Nevada, and California: 1) What are post-fire priorities for tribes in this region? 2) What are management options to address these priorities? 3) How are post-fire governance regimes affecting tribes? 4) What are governance barriers and opportunities to support post-fire recovery to meet the needs of tribes? Through a literature review, interviews, case studies, and roundtables, this project team (consisting of partners at Northern Arizona University, Colorado State University, and the Forest Service) will provide results to inform tribes, federal agencies, policymakers, and non-tribal forest stakeholders working on post-fire recovery.

4.4a: <u>Deliverable</u>: Report on progress.

ERI staff (N. vonHedemann and J. Martin) presented proposed research on tribes and post-fire governance to the Hopi Cultural Resource Advisory Task Force Team (CRATT) on Aug. 23, 2023. This included the Cultural Preservation Officer, Stewart Koyiyumptewa, and approximately 10 members of the CRATT and was an initial step to begin seeking approval for this research.

N. vonHedemann and J. Martin participated in approximately quarterly meetings with this SW CASC project research team, which is also working with other tribal nations in the west (Karuk Tribe, Washoe Tribe, and Santa Clara Pueblo).

4.5 Support to tribal climate adaptation partnerships.

Federal directives include integrating tribal voices, needs, and perspectives into climate vulnerability and adaptation planning. This has led to multiple new partnerships and working groups aimed at developing climate adaptation plans that address issues of social justice, ecological impacts, adaptation strategies, climate action plans, and tribal sovereignty to manage tribal lands. ERI will continue to provide knowledge and support to the development of these products, fostering partnerships with Southwest tribal fire and climate resiliency strategies and work groups, and through continued work with the SW CASC, Southwest Fire Science Consortium (SWFSC), the Tribal Burning Learning Network, Institute of Tribal Environmental Professionals (ITEP), The Nature Conservancy, and other groups.

4.5a: <u>Deliverable</u>: Report on progress.

The ERI provided subject matter expertise and editing support to a WFL case study within the CART (Conservation and Adaptation Resources Tool Kit), "[Wood For Life, a Collaborative Partnership to Provide Wood to the Navajo Nation and Hopi Tribe](#)."

Project 5. Science and Policy Application and Interpretation

5.1 Provide support to federal land managers with technical assistance, learning workshops, and presentations.

The ERI works closely with Forest Service partners at the district, forest, and regional scales to assess science needs and meet science questions with summaries of existing science. To reach broader audiences, we partner with our sister institutes at the SWERI and other boundary organizations to utilize West-wide webinar and workshop venues for science dissemination. In FY22, we worked with RMRS Science Delivery to initiate a joint webinar series. Together, we share science information from RMRS, academic and non-government organizational researchers to our combined audiences of over 400 attendees. Many of these projects are determined within the FY as fast responses to immediate needs.

5.1a: <u>Deliverable</u>: Shared learning via workshops or technical support to Forest Service to meet landscape restoration planning, implementation, and/or monitoring goals. Two to three (2–3) workshops or support.

This work has evolved to be captured with the deliverables in 5.1b (see below).

5.1b: <u>Deliverable</u>: Up to three (3) webinars or workshops in partnership with science-to-manager series, including the SWFSC, RMRS Science Delivery, or National Forest.

i. "[Wildlife and Fire in the Southwest Webinar Series](#)." Rocky Mountain Research Station and partners webinar series. ERI was on planning committee to develop and produce a series of five (5) webinars.

ii. "[Defining and identifying forest refugia and implications for future resiliency](#)." Science for Managers Webinar. Co-hosted by Rocky Mountain Research Station and Southwest Ecological Restoration Institutes. April 18, 2024.

   Connected Science bulletin

   Kantor, S., David, K., J.M. Iniguez, S. Parks, and **K.C. Rodman**. 2024. [Fire Refugia: Predicting locations of forest resistance and recruitment in a fire-prone world](#). *Connected Science*. Fort Collins, CO: US Department of Agriculture, Forest Service, Rocky Mountain Research Station and NAU Ecological Restoration Institute. 2 p.

iii. "[Sifting through selective science and misinformation for collaborative forest management](#)." Science for Managers Webinar. Co-hosted by Rocky Mountain Research Station and Southwest Ecological Restoration Institutes. April 24, 2024.

5.2 Climate adaptation in the southwestern region.

The ERI supports efforts with SW Climate Hubs and SW CASCs to engage cross-boundary climate adaptation audiences with shared learning. ERI will continue partnerships and work to advance climate adaptation planning, development of adaptation strategies and tactics within the southwestern US. We will provide continued support to work groups and the development of case studies within these work groups. We will provide support to Region 3 workshops rolling out the regional climate adaptation strategy and workshops focused on forest-level development of adaptation tactics (dependent upon Forest Service development of workshops). Continued work on products and support with the Southwest Climate Hubs, SW CASC, SWFSC, and the Southwest Fire Climate Adaptation Partnership (SWFireCAP).

5.2a: <u>Deliverable</u>: Provide support to forest-level climate adaptation workshops (set to start fall 2023).

In February 2024, a Climate Adaptation Workshop was jointly held by Forest Service Region 3, the SW Climate Hub, SW Fire Science Consortium, and the ERI in Flagstaff, Arizona, bringing together resource managers from the Kaibab and Coconino national forests. This workshop focused on broad climate impacts in the region, how climate is currently impacting natural resources in the area, current issues managers are facing, as well as identified adaptation tactics that may be used in planning and implementation for future climate resilience.

To support this workshop, **two webinars** were additionally delivered — one before the workshop to prep users for the work, and a second one following the workshop to review the monitoring components of the adaptative management plan.

Additionally, the ERI created and shared the R3 Climate Adaptation data through a [storymap](#), located on the [US Forest Service Data Dashboard](#), and the R3 Climate Data website.

5.2b: <u>Deliverable</u>: Provide support to a Phoenix, AZ Climate Hub workshop, spring 2024.

Partnerships with the USDA Southwestern Climate Hubs is important to the ERI. An in-person workshop was replaced with opportunities to share the Climate Hubs' FRIDA climate support tool to a variety of audiences in existing webinar series, including the refugia webinar (listed above in 5.1bii).

5.3 Translate and summarize scientific and journal articles for land managers and affected entities.

The ERI develops [white papers](#) that address socio-economic policy issues and [working papers](#) that summarize science applications for land managers. [Fact sheets](#) are two-page, brief summaries of peer-reviewed science and [Topics in Restoration and Resiliency](#) papers explore a broad restoration topic, like what fire scars tell us about the past and what to expect after restoration, written for a general audience.

5.3a: Three (3) white and/or working papers, potential topics to include:

5.3a.i: Deliverable: White paper: 4FRI: Lessons learned from 12 years and 2.4 million acres of collaboration.

This deliverable (4FRI history (2010–2022) white paper) was **pushed to FY24**. It has been replaced by a special report on findings from a needs assessment for the **Wood For Life** project.

vonHedemann, N., J. Martin, and A. Franko. 2025. Wood For Life: A Needs Assessment for Northern Arizona. ERI Special Report. Ecological Restoration Institute, Northern Arizona University. 28 p.

5.3a.ii: Deliverable: Working Paper: Pinyon pine: State of knowledge of pinyon pine ecological value, old growth characteristics, and vulnerability, with best management practices.

Huffman, D.W., J.D. Springer, and J.C. Martin. *IN REVIEW*. Opportunities for Application of Traditional Ecological Knowledge (TEK) in Restoration of Pinyon-Juniper Ecosystems of the Colorado Plateau. ERI Working Paper No. 46. Ecological Restoration Institute, Northern Arizona University. 42 pp.

5.3a.iii: Deliverable: Working Paper: Metrics of managed fire success: A summary of management recommendations from recent literature on measuring success across unplanned and managed ignitions.

This deliverable was pushed to the FY24 Work Plan. It has been replaced by a white paper by Franko et al. on Indigenous biomass use.

Franko, A., M.M. Colavito, N. vonHedemann, J. Martin, and A.J. Sánchez Meador. 2024. Indigenous Biomass Use for Forest and Community Well Being: A Case Study of Wood For Life. ERI White Paper—Issues in Forest Restoration. Ecological Restoration Institute, Northern Arizona University. 23 p.

5.3b: <u>Deliverable</u>: Six to eight (6–8) Fact Sheets and/or Topics in Restoration and Resiliency papers.

1. Colavito, M.M., E. Hjerpe, C. Edgeley, J. Burnet, T. Combrink, D. Vosick, and A.J. Sánchez Meador. 2023. [Calculating the Full Costs of the 2010 Schultz Fire: A Ten-Year Review](). ERI Fact Sheet. Ecological Restoration Institute, Northern Arizona University. 2 p.

2. Wasserman, T.N., and S.E. Mueller. 2024. [Climate Influences on Future Fire Severity: A Synthesis of Climate-Fire Interactions and Impacts on Fire Regimes, High-Severity Fire, and Forests in the Western US](). ERI Fact Sheet. Ecological Restoration Institute, Northern Arizona University. 2 p.

3. Rodman, K.C. 2023. [Refuge-yeah or Refuge-nah? Predicting Locations of Forest Resistance and Recruitment in a Fiery World](). ERI Fact Sheet. Ecological Restoration Institute, Northern Arizona University. 2 p.

4. Colavito, M.M., C.M. Edgeley, and N. vonHedemann. 2023. [Public Experiences with Wildfire and Flooding: A Case Study of the 2019 Museum Fire Near Flagstaff, Arizona](). ERI Fact Sheet. Ecological Restoration Institute, Northern Arizona University. 3 p.

5. Rodman, K.C. 2023. [Fire Regimes Over a 3,500-Foot Elevational Gradient, San Francisco Peaks/Dook'o'oosłííd, Arizona USA](). ERI Fact Sheet. Ecological Restoration Institute, Northern Arizona University. 2 p.

6. Franko, A., M.M. Colavito, N. vonHedemann, and A.J. Sánchez Meador. 2024. [Indigenous Biomass Use for Forest and Community Well-Being: A Case Study of Wood For Life](). ERI Fact Sheet. Ecological Restoration Institute, Northern Arizona University. 2 p.

Project 6. Communication and Outreach

6.1 Social media and innovative science delivery.

Over the last 6 years, the ERI has created and successfully launched a monthly [Science Flash]() e-mail with quick links to the latest ERI science, outreach product, or SWERI news. Additionally, our bi-annual newsletter, dispersed to more than 1,000 contacts, highlights each program of work and contains a complete listing of all recent publications and products. The ERI coordinates across all SWERI to cross-post and leverage intermountain and West-wide actionable science to our shared, diverse audiences. In FY23, the ERI will continue to grow our social media impact and develop innovative outreach across multiple media platforms.

6.1a: <u>Deliverable</u>: Media campaign link and Google analytic summaries.

- X Thread: **Long-term costs of wildfire: A case study of the 2010 Schultz Fire**. X (Twitter) thread. Sept. 28, 2023. https://twitter.com/ERI_NAU/status/1707468483720839339

- X Thread: **Museum Fire survey, public perceptions of wildfire and postfire flooding**. X (Twitter) thread. Nov. 13, 2023: https://twitter.com/ERI_NAU/status/1724115622446141846

- LIFE WITH FIRE PODCAST: Fire in the Southwest Series. Series episode 3/Ep. 66: **Integrating Indigenous Knowledge into Western Fire Management with Jon Martin**. June 26, 2024. https://lifewithfirepodcast.com/episodes/fire-in-the-southwest-series-ep-3-integrating-indigenous-knowledge-into-western-fire-management-with-jon-martin

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6.1b: <u>Deliverable</u>: ERI "Science Flash": ten to twelve (10–12).

1. September 2023. "Refuge-yeah or Refuge-nah?" ERI Science Flash. Sept. 26, 2023.

2. October 2023. "Calculating the Full Costs of Wildfire." ERI Science Flash. Oct. 30, 2023.

3. November 2023. "Experiences with Wildfire and Flooding: The 2019 Museum Fire." ERI Science Flash. Nov. 14, 2023.

4. December 2023. "Happy Holidays from the ERI. This holiday season, we're dreaming of a white … paper." ERI Science Flash. Dec. 21, 2023.

5. January 2024. "Publication Corner: Climate Influences on Future Fire Severity." ERI Science Flash. Jan. 23, 2024.

6. February 2024. "Upcoming Webinar: Sifting Through Selective Science and Misinformation." ERI Science Flash. Feb. 23, 2024.

7. April 2024. "Upcoming Webinar: Defining and Identifying Forest Refugia and Implications for Future Resiliency." ERI Science Flash. April 8, 2024.

8. May 2024. "Indigenous Biomass Use for Forest and Community Well-Bring: A Case Study of Wood for Life." ERI Science Flash. May 14, 2024.

9. June 2024. "New Paper: Long-Term Ecological Responses to Landscape-Scale Restoration." ERI Science Flash. June 11, 2024.

10. June 2024. "2024 IUFRO World Congress: Communicating and Connecting." ERI Science Flash. June 25, 2024.

6.1c: <u>Deliverable</u>: ERI biannual e-newsletter: Two (2).

1. ERI Winter 2023 Newsletter (Dec. 14, 2023): https://mailchi.mp/01d0d5558cd7/eri-fall-newsletter-6230082?e=be6aa91d56

2. ERI Summer 2024 Newsletter (June 6, 2024): https://mailchi.mp/9f58ed63f4ba/eri-fall-newsletter-6247097?e=be6aa91d56

6.2 Provide website support for the ERI, SWERI, and 4FRI to best meet deliverables.

6.2a: <u>Deliverable</u>: Report on actions. Includes website analytic reports on each website's user site visits and engagement metrics.

Analytics reports for the ERI, SWERI, and 4FRI websites are included as [enclosures](#).

6.3 Media outreach and engagement.

Support the education of the general public through media outreach.

6.3a: <u>Deliverable</u>: Ten (10) media interviews.

1. Sánchez Meador, A. Interviewed by Hayleigh Evans with the *AZ Republic* for a story on the 1990 Dude Fire and SRP's work to restore the burned watershed. Oct. 31, 2023

2. Sánchez Meador, A. Interview with Hayleigh Evans, *AZ Republic*, for a story on the new policy direction regarding old growth. Dec. 20, 2023

3. Sánchez Meador, A. Interview with Adrian Skabelund, *AZ Daily Sun*, for a story on the new Forest Service policy direction regarding old growth. Dec. 28, 2023

4. Waltz, A. Interview with Kevin Jonah with *AZ Business Magazine* for a story on forest health, wildfires, and the need for restoration. Jan. 19, 2024

5. Sánchez Meador, A. Interview with Ava Nichols with AZ Family/ CBS for an on-air story about ERI and the new Forest Service policy direction on old growth. Jan. 26, 2024

6. Sánchez Meador, A. Interview with Melissa Sevigny at KNAU Public Radio about the new Forest Service policy direction on mature and old growth forests. Jan. 31, 2024

7. Rodman, K. Interview with Camille Fassett at AP News about wildfire-driven ecosystem changes in western US, tree planting, and tree regeneration. April 11, 2024

8. Rodman, K. Interview with Jack Lee at *San Francisco Chronicle* to comment on Potter et al. study on drought and plant net primary productivity in North America. May 9, 2024

9. Sánchez Meador, A., D. Gosh, K. Rodman, N. vonHedemann, M. Colavito, A. Waltz. Interview with IUFRO film crew for video to air at IUFRO World Congress in Sweden. May 30, 2024

10. Roccaforte, JP. Interview with Jill Kimball for the *NAU Review* about the Roccaforte et al. 2024 paper on long-term ecological responses to landscape-scale restoration. June 2024

6.3b: <u>Deliverable</u>: Ten (10) media articles.

1. Celaya, A. 2023. "Over 120,000 Arizona homes at risk of wildfire damage, report says." *Arizona Republic*. Aug. 26, 2023.

2. NAU Communications. 2023. "Seven ways NAU and SRP are helping build stronger utility systems in Arizona." *The NAU Review*. Sept. 7, 2023.

3. Evans, H. 2023. "30 years after the deadly Dude Fire, work begins in the forest to prevent another disaster." *Arizona Republic*. Nov. 10, 2023.

4. NAU Communications. 2023. "Revolutionizing what we understand about America's forests." *The NAU Review*. Dec. 6, 2023.

5. Evans, H. 2023. "Forest Service proposes old growth management plans. Here's what to know in Arizona." *Arizona Republic*. Dec. 22, 2023.

6. Reid, C. 2024. "Recent discoveries revolutionize our understanding of the ecology of America's forests." *List23*. Jan. 16, 2024.

7. Skabelund, A. 2024. "Forest Service amending management of old-growth forest." *Arizona Daily Sun*. Jan. 23, 2024.

8. Nichols, A. 2024. "Friday night news spot on US Forest Service policy to protect old growth trees." AZ Family/CBS 3. Jan. 26, 2024.

9. Sevigny, M. 2024. "U.S. Forest Service proposes to protect old growth trees." KNAU Public Radio. Feb. 6, 2024.

10. Lee, J. 2024. "Federal study shows vast amount of forest lost in California after wildfires, drought." *San Francisco Chronicle*. May 11, 2024.

11. Evans, H. 2024. "Cutting trees, setting fires could help protect Flagstaff from new disaster." *Arizona Republic*. June 17, 2024.

6.4 Science support, knowledge resource services to federal and non-federal entities.

These activities include filling information requests, technical assistance, field trips, and presentations.

6.4a: <u>Deliverable</u>: A minimum of forty (40) services or activities.

1. Colavito, M. Will Greene in the land management policy unit with the Arizona Governor's Office called to request information on a variety of topics related to forest restoration and biomass utilization. Information was provided over the phone, as well as in a follow-up email. July 13, 2023. *Information request*

2. Colavito, M. and A. Waltz. Jake Dahlin with the Flagstaff Ranger District requested information about ERI research activities around the San Francisco Peaks. GPNA and Ft. Valley handouts were provided by email, as well as other information. Aug. 7, 2023. *Information request*

3. Colavito, M., A. Sánchez Meador, T. Dubay, and D. Huffman. Congressman Crane and staff requested a field trip to the restoration demo site at Ft. Tuthill. Field trip was organized for 14 participants to NAU and Ft. Tuthill. ERI handouts and materials were provided. 14 participants. Aug. 25, 2023. *Field trip*

4. Colavito, M., and A. Sánchez Meador. Jerry Perez, Director for Forest Service Fire and Aviation Management, requested a meeting at ERI and visit to restoration demo site to learn more about our work. Meeting and demo site visit were held, ERI handouts and materials were provided. Aug. 29, 2023. *Field trip*

5. Colavito, M. Tyler Head, a Master of Forestry student at NAU, requested a meeting to talk about CWPPs. Meeting held and CWPP white paper provided. Aug. 31, 2023. *Information request*

6. Colavito, M. Paul Babbitt with Senator Kelly's office emailed to request information about Lidar use in tree identification. Information was provided by email. Sept. 5, 2023. *Information request*

7. Colavito, M. Brandon Bragato with the House Natural Resources Committee used the SWERI Managed Wildfire [briefing paper](#) to help prepare remarks for a bill markup of HR 934. 9/18/23. Sept. 20, 2023. *Information request*

8. Waltz, A., and M. Colavito. Presentation on "[Changing Climate, Forests and Fire in Arizona](#)" for the Flagstaff Festival of Science "Healthy Forests and a Fire-Adapted Flagstaff" session with M. McGrath and N. Chapman. 30 participants. Sept. 25, 2023. *Presentation*

9. Rodman, K. and M. Stoddard. Local field visit with Chris Curley (Coconino NF) to observe and discuss ponderosa pine pinecone collection for reforestation. Sept. 27, 2023. *Field trip*

10. Colavito, M. Henry Bastian with DOI requested the work SWERI/ERI has done on Risk Management Assistance (RMA). Report and briefing papers were provided by email. Oct. 11, 2012. *Information request*

11. Colavito, M. Paul Babbitt with Senator Kelly's office emailed to request information and perspectives related to some questions about 4FRI. Response provided by email. Oct. 16, 2023. *Information request*

12. Dubay, T. Spoke with *AZ Republic* enviro reporter Hayleigh Evans on background about ERI research and the story Hayleigh's working on related to SRP's watershed restoration of the 1990 Dude Fire. Referred her to A. Sánchez Meador for an interview related to that story. Oct. 16, 2023. *Media request*

13. Rodman, K., D. Huffman, J. Martin, N. vonHedemann, and D. Ghosh. Meeting with Matt Honanie (from Hopi) and Forest Service staff to discuss planting program and research related to reforestation on Hopi lands. Followed up with brief science synthesis about tree planting in pinyon-

juniper, and Forest Service RFP related to supporting tribal-led planting efforts on Forest Service lands. Oct. 26, 2023. *Technical assistance*

14. Dubay, T. Bryce Esch, Forest Service CFLRP Coordinator, email about a collaborative group looking for resources to structure their comms work group. The 4FRI Comms WG charter and protocols were provided. Nov. 3, 2023. *Information request*

15. Waltz, A., and M. Colavito. Ian Fox with the Forest Service Washington Office Wildfire Risk Reduction Investment Team emailed to ask for information about wildfire costs and avoided costs. Provided a copy of the recent Schultz full cost accounting manuscript and fact sheet and mentioned forthcoming benefit cost analysis study. Nov. 20, 2023. *Information request*

16. Colavito, M., and N. vonHedemann. Lucinda Andreani and Jay Smith with Coconino County requested a meeting to review the recent Museum Fire survey findings and requested additional briefings specific to forest management perceptions and ecological research information around the San Francisco Peaks. Nov. 28, 2023. *Technical assistance*

17. Colavito, M. Matthew Dickinson with the Forest Service Northern Research Station requested the recent refugia paper. The paper and recent science flash were provided by email. Dec. 12, 2023. *Information request*

18. Colavito, M. Jay Smith with Coconino County requested ERI Topics in Restoration papers to share with County Board of Supervisors. Topics papers list and suggestions provided by email. Dec. 12, 2023. *Information request*

19. Sánchez Meador, A. Jay Smith with Coconino County requested a presentation on restoration basics to the County Board of Supervisors meeting. Presentation provided. 15 attendees. Jan. 9, 2024. *Presentation*

20. Colavito, M. Debra Grossman with the Red Lakes HOA near Williams emailed to request information and/ or assistance with a project being done by DFFM in the area. Concept paper on collaboration was provided by email. Jan. 17, 2024. *Information request*

21. Colavito, M. Emery Cowan and Cole Jensen with the Rural Voices for Conservation Coalition asked for facilitation assistance on a peer learning session on the Wildfire Crisis Strategy. Facilitation was provided. Jan. 23, 2024. *Facilitation*

22. Colavito, M. Tracee Sutton with Congressman Stanton's office called to ask for a review and additional information for a proposed bill regarding FEMA and wildfire. Brief written remarks and facts from the Schultz and Museum studies were provided by email. Jan. 30, 2024. *Information request*

23. Dubay, T. Neil Chapman with the City of Flagstaff Wildland Fire Department called to request copies of ERI's Restoration for Homeowners guide to hand out to residents as his team gears up for spring Firewise outreach. Jan. 31, 2024. *Information request*

24. Colavito, M. Attended National Forest Foundation Northern Arizona Forest Fund Annual Advisory Council meeting. Provided advisory information to council. Jan. 31, 2024. *Information request*

25. Colavito, M., N. vonHedemann, C. Edgeley. Presentation to the Flagstaff City Council meeting on recent social science findings on forest and fire management. Provided a presentation and briefing paper to City Council through invitation by Neil Chapman. Feb. 13, 2024. *Presentation*

26. Colavito, M., N. vonHedemann, C. Edgeley. Presentation to the Coconino National Forest Leadership Team meeting on recent social science findings on forest and fire management.

Provided a presentation and briefing paper to Forest Leadership Team through invitation by Matt McGrath. Feb. 14, 2024. *Presentation*

27. Colavito, M., and N. vonHedemann. Council Member Harris from Flagstaff City Council asked for additional information on socio-economic trends in insurance uptake for flooding in Flagstaff. A draft research note currently in peer review on the topic was provided. Feb. 22, 2024. *Information request*

28. Waltz, A., and M. Colavito. Emery Cowan and Cole Jensen with the Rural Voices for Conservation Coalition asked for facilitation assistance on a peer learning session on the Wildfire Crisis Strategy. Facilitation was provided. Feb. 29, 2024. *Facilitation*

29. Stoddard, M. Data request by Andy Stevensen (Forest Silviculturist) for HRV forest structure specific to Kaibab Plateau to inform Burnt Corral project. Feb. 27, 2024. *Information request*

30. Stoddard, M. Information request for understory post-fire monitoring and experimental design by Dave Passovoy (Environmental Scientist) California Dept. of Forestry and Fire protection. March 21, 2024. *Information request*

31. Sánchez Meador, A., and M. Colavito. Katy Yanez with the NAU President's office emailed to request feedback on a legislative proposal titled, "Regional Leadership in Wildland Fire Research." Feedback provided by email and in a meeting. March 25, 2024. *Information request*

32. Colavito, M. Collin Haffey with Washington State Department of Natural Resources emailed to ask for information about surveys on decision support tools. The Risk Management Assistance Survey from the 2021 fire season report was shared as an example. March 26, 2024. *Information request*

33. Colavito, M. Karen Hardigg, consultant with Hardigg Solutions, asked for a meeting and information from ERI to inform a facilitated meeting with the Council of Western State Foresters. A briefing paper on ReShape, a briefing paper on the Vorster et al. publication, and a report on outcome performance measures were shared. April 3, 2024. *Information request*

34. Rodman, K. Meeting with Libby Pansing (American Forests) and Marin Chambers (CFRI) to discuss northern Colorado post-fire landscape management plan. April 1, 2024. *Meeting and Information request*

35. Colavito, M. Kristin Sleeper, a policy staffer with the Senate Energy and Natural Resources committee in Congress, requested feedback on some legislative proposals involving SWERI and forestry topics. Feedback provided by email. April 15, 2024. *Information request*

36. Colavito, M. Kim Shaw with the Flagstaff Leadership Program invited the ERI to sit on a panel called, "Yay Science," for Flagstaff Leadership Program participants. Panel and breakout group presentations were provided, along with ERI materials. 25 participants. May 16, 2024. *Presentation*

37. Dubay, T. Ryan Fitch, an economist with NAU's School of Business, requested photos of immediate post-treatment and one-year post-treatment to demonstrate that treated areas looked disturbed at first but quickly recover. Photos of the Ft. Tuthill demo treatments were provided. June 13, 2024. *Information request*

38. Waltz, A., and A. Sánchez Meador. Ariel Leonard with the Forest Service R3 office requested fact sheets and information about Gus Pearson NA and old growth. The most recent fact sheet about GPNA, as well as another fact sheet and publication were provided by email. June 21, 2024. *Information request*

39. Dubay, T. Gary Ferguson, author and nature writer, reached out to M. Colavito and T. Dubay about a book he's writing for Island Press on the ponderosa pine. He requested to speak with ecology experts at ERI. June 25, 2024. *Interview request*

40. Rodman, K. Meeting with Serra Hoagland, USDA Forest Service Washington Office, to discuss Salt Fire (near Ruidoso, NM and Mescalero lands) burn severity assessments. Developed and provided initial burn severity maps using Sentinel-2 imagery, to support Serra's work with Mescalero Apache, and assessment of initial post-fire risk until federal efforts are complete. June 24, 2024. *Information request*

6.5 Report on FY23 Work Plan activities to SWERI Program Manager.

6.5a: <u>Deliverable</u>: FY23 final report to SWERI Program Manager.

This report serves as the final deliverable for 6.5a.