

2018 Annual Report

to the USDA Forest Service under Sponsor Award

#18-DG-11031600-057 for 2018 (NAU Projects 1003729-1003734)



Submitted by:

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Summary

This report presents an integrated and coordinated series of actions in Fiscal Year 2018 (\$1.3 million) under CFDA 10.694, Southwest Forest Health and Wildfire Prevention.

The information provided herein reflects our annual progress as of July 1, 2019 and comprises the final report for 2018 deliverables under 18-DG-11031600-057 (NAU Projects 1003729-1003734).

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 that includes 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 Forest Service has provided for these efforts.

Annual Report to the **USDA Forest Service** for 2018

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Project 1: Science Delivery and Support for Collaborative Restoration and Conservation from the Local to Landscape Scale	
Deliverable	Status
1.1) Science delivery, leadership, and administrative support for the Four Forest Restoration Initiative (4FRI), a Collaborative Forest Landscape Restoration Act project.	
<p>a) <u>Deliverable</u>: Report on leadership activities (stakeholder group and working groups).</p> <p>b) The ERI will work with 4FRI Multi-Party Monitoring Board (MPMB) and Monitoring Coordinator, with R3 FVS to analyze pre-treatment data. In addition, the ERI will analyze data management challenges and create recommendations that are designed to facilitate adaptive management. <u>Deliverables</u>:</p> <p>i. Monitoring report that includes an analysis of pre- and post-vegetation data.</p> <p>ii. Presentation of monitoring results to the 4FRI Stakeholder Group and Forest Service 4FRI team.</p> <p>iii. Data management report discussing the process steps required to incorporate MPMB collected data and the external analysis back into the federal database.</p> <p>iv. Presentation of findings to Region 3, Washington Office Inventory, Monitoring and Assessment Program at the Washington Office.</p>	<p>a) Report on leadership activities:</p> <ul style="list-style-type: none"> • Waltz, A.E.M. Ongoing. Provides leadership, coordination, and support to the Rim Country DEIS Workgroup for stakeholder comment development. • Esch, B.E. Ongoing. Provides leadership, coordination, and support to the 4FRI MPMB Workgroup. • Vosick, D. Ongoing. Provides leadership, monthly coordination and support to the 4FRI Stakeholder Group and Steering Committee Calls. • Colavito, M. Ongoing. Provides leadership, coordination, and support for the 4FRI Strategic Plan and CFLRP re-authorization process <p>b) Report on deliverables:</p> <p>i. & iii. Esch, B., and A.E.M. Waltz. 2019. Four Forest Restoration Initiative (4FRI) Rapid Plot Pre-Treatment Monitoring Report. ERI Technical Report. Ecological Restoration Institute, Northern Arizona University.</p> <p>ii. Presentation to 4FRI MPMB to be completed on November 13, 2019.</p> <p>iii. See i. above.</p> <p>iv. Waltz, A.E.M. and B.E. Esch. Gaps on the Way to Adaptive Management: A Collaborative Monitoring Pilot on Forest Service lands, Society for American Foresters Conference, Portland, OR. This presentation captured process and initial findings. Oct. 25, 2015. 25 attendees.</p> <ul style="list-style-type: none"> • Presentation to Region 3, WO IMA moved to 2019 deliverables to include the findings from the final October 2019 analysis.

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<p>c) Report on IT support for the 4FRI website and BASECAMP (an online collaborative work space) and administrative support, including minutes and agendas.</p>	<p>c) Norton, H. Ongoing. Maintains all website support.</p> <ul style="list-style-type: none"> • Jourden, A. Monthly management of all administrative tasks related to the Stakeholder Group meetings. This includes: agendas, minutes, room scheduling, presentation scheduling, copying, and BASECAMP. • Esch, B. Monthly management of Steering Committee calls. This includes: agendas, minutes, and coordination.
<p>1.2) Analysis of 23 CFLR pilots to assess the monitoring questions, metrics and the database management used to measure biophysical restoration success.</p>	
<p>a) <u>Deliverable</u>: White paper and seminar.</p>	<p>a) Report on deliverables:</p> <ul style="list-style-type: none"> • Esch, B., and A.E.M. Waltz. 2019. Assessing Metrics of Landscape Restoration Success in Collaborative Forest Landscape Restoration Projects. ERI White Paper. Ecological Restoration Institute, Northern Arizona University. (<i>Report is included in this document, click here.</i>) • Seminar changed to presentation at R2–R3 CFLRP workshop, to be held March 2–4, 2020. There has been a lapse in monitoring-focused webinars, and we have lost the designated audience for these topics. To reach the intended audience, we will present at the National CFLRP workshop scheduled for March 2020 (FY19 deliverable). • Ongoing – July 2, 2018 to present. Support for the National CFLRP ecological indicator 10-yr report that includes participation and strategy development with Lindsay Buchanan, the CFLRP Coordinator, Forest Service Washington Office, DC.

Project 2: Evaluation and Synthesis of Best Available Scientific Information (BASI) for Landscape Restoration West-Wide

Deliverable	Status
<p>2.1) Evidence-based review of the literature on tree regeneration dynamics in frequent-fire forests and implications for restoration.</p>	
<p>a) <u>Deliverable</u>: Synthesis of Best Available Science.</p> <p>b) <u>Deliverable</u>: Presentation at professional conference and to stakeholder group or practitioners.</p>	<p>a) Wasserman, T.N., A.E.M. Waltz, J.P. Roccaforte, J.D. Springer, and J.E. Crouse. 2019. Natural regeneration responses to thinning and burning treatments in ponderosa and Jeffrey pine forests and implications for restoration. Manuscript in development. To be submitted to <i>Forest Ecology and Management</i> by Dec. 15, 2019.</p> <p>b) Presentation to 4FRI ID team by November 2019.</p>

Project 3: Monitoring, Evaluation, and Adaptive Management of Landscape Restoration in Western Fire-Adapted Forests and Woodlands

Deliverable	Status
<p>3.1) Continue long-term studies in southwestern mixed-conifer and ponderosa pine forests (LEARN)</p>	

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<p>a) <u>Deliverable</u>: Report on progress toward treatment implementation of a mixed conifer restoration project in the Mogollon Rim Ranger District of the Coconino National Forest (build from FY2015).</p> <p>b) Remeasurement (10-year) of mixed conifer project on San Juan National Forest, Colorado; collaboration with Dr. Julie Korb at Fort Lewis College. <u>Deliverables</u>:</p> <p>ii. Manuscript for publication.</p> <p>iii. Presentation to stakeholder group, agency staff, or professional conference.</p> <p>c) <u>Deliverable</u>: Report on progress toward collection of pre-burn data at ponderosa pine project sites on Ft. Valley Experimental Forest (15-20 years) and preparation for subsequent response measurements.</p>	<p>a) Report on progress:</p> <ul style="list-style-type: none"> • Continued communications with Forest Service staff on treatment implementation. <ul style="list-style-type: none"> ○ In FY18, the General Springs timber sale was offered. It included ERI treatment blocks. There were no bids. The treatments are now part of the National Wild Turkey Federation MSA. Treatment is planned for the fall of 2019 or summer 2020. • Initiated conversations with the National Wild Turkey Federation concerning their MSA. <ul style="list-style-type: none"> ○ Progress was made in developing a memorandum of understanding between NWTF, ERI, SRP, and Forest Service. To date, the MOU has not been finalized and SRP has stepped back. • Clarified with Forest Service our needs for long-term protection of study site. <ul style="list-style-type: none"> ○ Plans are set for the ERI to confirm study block boundaries and on-ground delineation. • Completed recording all sample plot locations with high-accuracy global positioning system. <ul style="list-style-type: none"> ○ This field work will have several benefits, including improved communication with Forest Service and other project partners and providing data for associated studies. <p>b) Report on deliverables:</p> <p>i. Manuscript for publication – <i>Completed and submitted to journal</i></p> <ul style="list-style-type: none"> • Korb, J.E., Stoddard, M.T., Huffman, D.W. The importance of long-term studies for quantifying forest restoration effects and temporal dynamics: an example from warm/dry mixed-conifer in southwestern Colorado. (<i>Manuscript is included in this document, click here.</i>) <p>ii. Presentation to stakeholder group – <i>Completed</i></p> <ul style="list-style-type: none"> • Korb, J.E. 2019. The transient nature of warm/dry mixed-conifer restoration treatment effects on understory vegetation and fuels 10 years post-treatment. Presentation given to the San Juan Headwaters Forest Health Partnership, Pagosa Springs, Colorado. 26 participants. <p>c) Report on progress:</p> <ul style="list-style-type: none"> • Data from these measurements are being used in analysis of LiDAR accuracy for estimating canopy fuels, and will be used in out-years for analysis of tree survival and long-term fuels dynamics under alternative restoration prescriptions. • Pre-burn overstory tree data collected. • Fuels data collected.
<p>3.2) Continue collaborative studies with the Prescott and Tonto national forests on historical conditions and restoration prescriptions for transitional ponderosa pine forests.</p>	

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<p>a) <u>Deliverable</u>: Manuscript for publication.</p> <p>b) <u>Deliverable</u>: Presentation for stakeholder group, agency staff, or professional conference.</p>	<p>a) Manuscript for publication – <i>completed and submitted to journal</i></p> <ul style="list-style-type: none"> • Huffman, D.W., M.L. Floyd-Hanna, D.P. Hanna, J.E. Crouse, P.Z. Fulé, A.J. Sánchez Meador, J.D. Springer. Historical fire regimes and structure of ponderosa pine forests in Arizona’s Transition Zone. <i>(Manuscript is included in this document, click here.)</i> <p>b) Presentation to agency staff:</p> <ul style="list-style-type: none"> • Huffman, D.W., et al. 2019. Fire regime and structural changes in oak-pine forests of the Mogollon Highlands ecoregion, Arizona. Presentation given to US Forest Service staff and leadership. May 2019. ~15 participants. • Huffman, D.W., et al. 2019. Ecological effects of fuels treatments on the Prescott National Forest. Presentation given to US Forest Service staff and leadership. May 2019. ~15 participants.
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3.3) Support development of software platform for fusing remote sensing data (e.g., LiDAR point cloud segmentation of individual trees and imagery-derived species information) and forest inventories to assist managers in forest landscape assessments.

<p>a) <u>Deliverable</u>: Fact Sheet: Overview of LiDAR-derived products commonly used in forest ecosystem assessments.</p> <p>b) <u>Deliverable</u>: Needs Assessment Report and set of half-day focus group workshops (2-3) targeting resource managers and interdisciplinary specialists to identify standardized data products needed to facilitate analyses, assessment of landscape condition, and treatment potential and implementation.</p>	<p>b) Fact Sheet:</p> <ul style="list-style-type: none"> • Donager, J., A.J. Sánchez Meador. 2019. Understanding LiDAR for Forest Applications. ERI Fact Sheet. Ecological Restoration Institute, Northern Arizona University. 2p. <p>c) Needs Assessment Report and set of half-day focus group workshops:</p> <ul style="list-style-type: none"> • Sánchez Meador, A.J. 2019. LiDAR for resource characterization, planning and implementation: Observed needs and potential solutions from a half-day workshop. Final report for the Ecological Restoration Institute, Northern Arizona University, Flagstaff, AZ. 12 p. <i>(Report is included in this document, click here.)</i> • Organized two workshops targeting Agency staff (April 30, 2019) and Collaborators/Stakeholders (May 2, 2019) familiar with LiDAR’s usages and applications. Corresponded with approx. 30 individuals, assessing interests, topics, and availability. ERI provided logistics support and facilitation assistance. • Sánchez Meador, A.J., Colavito, M., and Donager, J.J. 2019. Lidar focus Group Workshop. Facilitated, small focus-group workshop given to US Forest Service staff. April 30, 2019. ~13 participants. The US Forest Service workshop was well attended by 13 participants representing a variety of resource areas. The workshop was formatted to include a mixture of brief presentations, hands-on group exercises with facilitated discussion, and guided group discussions on barriers, concerns, efficiencies, and how LiDAR might be institutionalize within the Agency. Response and feedback were positive and outcomes were described in associated report.
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	<ul style="list-style-type: none"> • Collaborators/Stakeholders (May 2, 2019) workshop was canceled due to lack of interest and availability. i.e., only two of the 14 individuals targeted requested reservations when the workshop call was posted. Two additional individuals express interested but had scheduling constraints.
3.4) Collaborate with the Arizona National Guard to develop a mixed-conifer restoration demonstration site at Camp Navajo.	
a) <u>Deliverable</u> : Progress report.	a) Report on progress: <ul style="list-style-type: none"> • Continued internal discussions and conducted field visits to the Camp Navajo site. <ul style="list-style-type: none"> ○ After discussion, map development, and field visits, we determined that developing a restoration demonstration at this site will be lower priority for the ERI. Sites on Forest Service lands near Flagstaff appear to have greater potential for meeting the intention of this project than the site at Camp Navajo.

Project 4: Understanding and Solving the Economic, Social, and Political Issues and Opportunities of Ecological Restoration.

Deliverable	Status
4.1) Support implementation of recommendations developed at the November 2017 “Accelerating Implementation” workshop.	
a) <u>Deliverable</u> : Report on the progress made on action items from the November 2017 workshop with an emphasis of co-defining with the Forest Service the methods and opportunities to collect lessons learned and share them with other regions and units of the Forest Service. b) <u>Deliverable</u> : Workshop designed in cooperation with relevant units of the Forest Service. Follow-up webinars quarterly to track progress.	a) This deliverable shifted from a follow-up of the 2017 “Accelerating Implementation” Workshop to a new workshop requested by Region 3. In late 2018, The Nature Conservancy and Coconino County expressed frustration to Region 3 about the slow pace of progress in the adoption of innovations that would help industry and improve the efficiency of Forest Service project implementation. Region 3 asked the ERI to work with the partners to help identify a set of transformational priorities that would receive focus during the 2019 field season. On April 17, 2019 the ERI facilitated a workshop for the Forest Service and partners to discuss the transformational priorities and to create a common understanding of how implementation would proceed. <ul style="list-style-type: none"> i. Partner transformational priorities compiled for Region 3. <i>(Report is included in this document, click here.)</i> ii. “2019 Transformational Change Priorities for the Forest Service and Partners: Four Forest Restoration Initiative (4FRI) Implementation.” Workshop Report. May 12, 2019. <i>(Report is included in this document, click here.)</i> b) See above for workshop description. <ul style="list-style-type: none"> • Webinar coordination, facilitation and tracking of the priority modernization action items identified during the November 2017 workshop. Webinars were held on Sept. 5, 2018; Feb. 20, 2019; May 15, 2019.

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4.2) Provide constructive feedback on proposed actions informed by 4FRI Innovations implementation experience, consultation with outside partners and Forest Service staff on the following topics: Appraisals, Contracts, Accountability, Sale Layout, and Training.	
<p>a) <u>Deliverable</u>: A short, written summary of lessons learned and observations as a result of participation in this effort. Although the Forest Service did not require this deliverable, the ERI is committed to documenting and sharing lessons learned that may benefit future strategic planning efforts.</p> <p>b) <u>Deliverable</u>: Distribution of the summary to appropriate Forest Service leadership and staff.</p>	<p>a) During the course of this project, the ERI provided counsel in response to requests from the Forest Products Modernization team:</p> <ul style="list-style-type: none"> • Feedback on performance measures to Deb McGlothlin. Sept. 14, 2018. • Communication to John Crockett regarding “culture” issues at the Forest Service and how to approach them from the perspective of business practices. Oct. 23, 2018. <i>(Fact sheet is included in this document, click here.)</i> • Observations from partner listening sessions sent to Deb McGlothlin, David Cawrse. Nov. 6, 2018. <i>(Report is included in this document, click here.)</i> • Regular attendance and input during FPM leadership calls. • Feedback on Comprehensive Strategy sent to Deb McGlothlin, Dave Cawrse and Steve Aporta. March 19, 2019. • Final Report on Forest Products Modernization sent to John Crockett, Deb McGlothlin and David Cawrse. July 19, 2019. <i>(Report is included in this document, click here.)</i> <p>b) Report of observations presented to the FPM core team on August 12, 2019.</p>

Project 5: Improving Forest Operations and Biomass Utilization	
Deliverable	Status
5.1) Evaluate current log and biomass transportation practices, including weight scaling and selection of trucks.	
<p>a) <u>Deliverable</u>: Technical report summarizing the effect of using weight scales and optimal truck selection on transportation efficiency.</p> <p>b) <u>Deliverable</u>: Presentations to disseminate the study results at professional conferences.</p>	<p>Federal funding in Project 5 is used to support some of the administrative and professional services needed by the NAU Forest Operations and Biomass Utilization Program. The majority of the program budget is provided by Northern Arizona University and the State of Arizona.</p> <p>*See detailed explanation on work performed in FY18 below.</p>
5.2) Develop an implementation plan for a research and demonstration project designed to test mobile processing systems operated at or near the forest.	
<p>a) <u>Deliverable</u>: Report on the economics and operations logistics of mobile</p>	<p>Federal funding in Project 5 is used to support some of the administrative and professional services needed by the NAU Forest Operations and Biomass</p>

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<p>processing systems that run at or near the forest.</p> <p>b) <u>Deliverable</u>: Report on how a mobile processing system can be set up logistically and operated.</p>	<p>Utilization Program. The majority of the program budget is provided by Northern Arizona University and the State of Arizona.</p> <p>*See detailed explanation on work performed in FY18 below.</p>
<p>5.3) Develop a forest products business cluster plan consisting of various wood processing and utilization facilities in northern Arizona.</p>	
<p>a) <u>Deliverable</u>: Technical report explaining how manufacturing facilities within a forest products business cluster support each other and key factors determining the successful location of a business cluster.</p>	<p>Federal funding in Project 5 is used to support some of the administrative and professional services needed by the NAU Forest Operations and Biomass Utilization Program. The majority of the program budget is provided by Northern Arizona University and the State of Arizona.</p> <p>*See detailed explanation on work performed in FY18 below.</p>
<p>*FY18 was the first full year of operation for the ERI’s Forest Operations and Biomass Utilization program. As mentioned previously the majority of funding for this program comes from State of Arizona sources. Federal funding is used for technical and administrative support. Project priorities were shifted from the originally proposed work plan described in this report in order to take advantage of opportunity to launch a pilot project testing the exporting of wood chips to markets in South Korea. This pilot project received support from the US Forest Service, Coconino County, the Arizona Department of Forest and Fire Management and the forest products industry because it can provides practical information to help expand markets for small-diameter wood. The pilot project became a full time endeavor that precluded previously identified projects. In addition, the original work plan anticipated external grant funding that was not realized.</p> <p>The lessons learned from this project will published in a report by December 31, 2019.</p>	

Project 6: Science Delivery and Outreach to National, Western, and Southwestern Audiences: Federal, State, Tribal, and Private Forestry

Deliverable	Status
<p>6.1) Provide support to federal land managers for restoration treatment planning and implementation.</p>	
<p>a) <u>Deliverable</u>: Report on science delivery to support project assessments, data collection, treatment design and use of best available science by federal land managers.</p> <p>i. A combination of ten (10) total services based on previous and anticipated demand that may include:</p>	<p>a) Report on deliverable:</p> <p>i. A combination of ten (10) services:</p> <ol style="list-style-type: none"> 1. Waltz, A.E.M., J.P Roccaforte, and ERI Staff. Field tour and NRV discussion with Apache-Sitgreaves staff and forest leadership. Vernon, AZ. 23 Forest Service participants. Sept. 27, 2018. <i>Field Trip</i> 2. Wasserman, T. Kaibab National Forest silviculturist request for information and recommendations on dwarf mistletoe. Dec. 3, 2018. <i>Information Request</i>

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<p>workshops, information requests, technical assistance, field trips, and presentations.</p> <p>ii. Present (2) webinars in partnership with the Southwest Fire Science Consortium and/or National Forest Foundation to present emerging science to land managers and practitioners.</p> <p>b) <u>Deliverable</u>: Workshops to disseminate science information directly to practitioners.</p> <p>i. Workshop among Tonto National Forest, Prescott National Forest, ERI, and Prescott College to disseminate information from transitional pine work.</p> <p>c) <u>Deliverable</u>: Report on Rapid Assessments (RAPs) to support restoration projects at forest-level.</p> <p>i. RAP support for restoration projects at forest level.</p> <p>1. Revisit the Pinaleno dry-mixed conifer demo site for re-measurement following the Frye Wildfire.</p> <p>2. Collaborate with the Arizona National Guard/Camp Navajo to conduct a RAP and establish a dry-mixed conifer demonstration area.</p> <p>d) <u>Deliverable</u>: Report assessing TNC's tablet</p>	<p>3. Stotts, C.S. with D. Huffman. 2018. Field season debrief and initial findings on Tonto NF. Also presented Working Paper 38. Payson Ranger District, 15 attendees. Dec. 19, 2018. <i>Presentation</i></p> <p>4. Waltz, A.E.M. Information request regarding best practices for collaboration. Marsha Kellog, New Mexico planning consultant with Sandia Ranger District, Cibola NF and Soil & Water Cons District. March 14, 2019. <i>Information Request</i></p> <p>5. Waltz, A.E.M., D.W. Huffman. ERI update and regeneration study presentation. Flagstaff Ranger District, Coconino NF. April 3, 2019. 15 attendees. <i>Presentation</i></p> <p>6. Stotts, C.S. Linked a student researcher to Forest Service fire ecologist interested in using LiDAR for monitoring forest structure. Alex Spannuth, Kaibab NF. June 10, 2019. <i>Technical Assistance</i></p> <p>7. Stotts, C.S. Request for understory response info in transitional pine. Mary Lata – Tonto NF. July 15, 2019. <i>Technical Assistance</i></p> <p>8. The 4FRI stakeholders and 4FRI Forest Service interdisciplinary (ID) team organized a session at the North American Forest Ecology Workshop to share learning with land managers:</p> <p style="margin-left: 20px;">a. Waltz, A.E.M. 4FRI Role of Best Available Science in 10 years of 4FRI. NA Forest Ecology Workshop. Invite by Travis Woolley. June 24, 2019. 30 attendees. <i>Presentation</i></p> <p style="margin-left: 20px;">b. Waltz, A.E.M. 4FRI Optimization on Prioritization of the first EIS. NA Forest Ecology Workshop. Invite by Travis Woolley. June 24, 2019. 30 attendees. <i>Presentation</i></p> <p>ii. Report on webinar services</p> <p style="margin-left: 20px;">1. Waltz, A.E.M. National CFLRP All-Hands Meeting/Webinar, Panel Presentation, Lindsay Buchanan, CFLRP Coordinator, Washington Office, DC, Panel member. Nov. 15, 2019. 100+ attendees</p> <p style="margin-left: 20px;">2. Esch, B.E. 4FRI Monitoring and CFLRP Landscape Monitoring. Webinar Presentation, National Forest Foundation. May 29, 2019. 65 attendees.</p> <p>b) Report on deliverables:</p> <p style="margin-left: 20px;">i. Waltz, A.E.M. and D.W. Huffman, with ERI staff. Prescott and Tonto transitional pine fire history, and treatment effectiveness preliminary results. Prescott NF, Prescott, AZ, 15, *note, field trip/workshop was canceled due to weather, became a science delivery directly to Prescott NF. Tonto/Prescott Workshop is rescheduled for Nov. 15, 2019.</p> <p>c) Report on Rapid Assessment deliverables:</p> <p style="margin-left: 20px;">i. RAP support for restoration projects:</p> <p style="margin-left: 40px;">1) Waltz A.E.M., C. Stotts, J. Crouse, and M.T. Stoddard. 2019. The Pinaleno Ecological Restoration Project and Demonstration Unit: Effects of restoration treatment and wildfire in a mixed-conifer forest. Rapid Assessment Report. Ecological Restoration Institute,</p>
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<p>technology for restoration effectiveness and efficiency.</p> <p>i. Partner with TNC and Campbell Global to develop restoration metrics for tablet-based prescriptions; assess for additional prescription guidelines to meet restoration desired conditions.</p>	<p>Northern Arizona University. <i>(Report is included in this document, click here.)</i></p> <p>2) Stotts, C., A.E.M. Waltz, and M.T. Stoddard. 2019. Ponderosa Pine Forest Restoration: An Educational Demonstration Site at Fort Tuthill County Park. Rapid Assessment Report. Ecological Restoration Institute, Northern Arizona University. **The location for this deliverable was changed due to the fact that Fort Tuthill provided an excellent opportunity with more access to the public restoration outreach.</p> <p>d) Change in deliverable:</p> <p>i. Timelines interfered with developing restoration prescription experiments within the MSA of The Nature Conservancy. This deliverable is considered to be a long-term, multiyear goal, to be further explored with all partners. Instead, we helped the 4FRI MPMB and TNC MSA meet assessment requirements for Chimney Springs task order. The assessment quantified pre-treatment spatial heterogeneity at Chimney Springs.</p> <ul style="list-style-type: none"> • Stotts, C., Sánchez Meador, A., Waltz, A.E.M., Esch, B. 2019. An evaluation of pre-treatment spatial structure in the 4FRI Chimney Springs project area. Technical Report. Ecological Restoration Institute, Northern Arizona University. <i>(Report is included in this document, click here.)</i>
<p>Deliverable</p>	<p>Status</p>
<p>6.2) Assist with forest planning and implementation by recommending best available science and program support.</p>	
<p>a) The Kaibab National Forest (KNF) has requested assistance for analysis and summary of ground-based “rapid plot” data collected for baseline KNF forest plan monitoring. <u>Deliverable:</u> Data summaries, process to incorporate relevant data into the Forest Service database.</p> <p>b) Prescott National Forest (PNF) has requested assistance to increase reporting efficiency for the biennial report required by the 2012 Forest Planning Rule. <u>Deliverable:</u> Report on biennial template utilization and success by PNF.</p>	<p>a) Database summary</p> <ul style="list-style-type: none"> • Esch, B.E., and A.E.M. Waltz. 2019. Kaibab National Forest Monitoring Report. 2019. Technical Report. Ecological Restoration Institute, Northern Arizona University. • Esch, B.E. Using Best Available Science Information: Recommendations for Context-based Decisions, Society of American Foresters Conference, Portland, OR. Oct. 5, 2018. 25 attendees. <p>b) This deliverable topic was too similar to efforts developed by US Forest Service Resource Inventory and Monitoring Coordination Group (RIMC) at the Washington Office. Instead, ERI staff worked closely with Kaibab National Forest to modify a 2017 pilot Access database, and coordinated with the 4FRI deliverable in 1.1, that holds all years of forest plan monitoring.* Access database was delivered with final report 9/30/2019.</p> <p>*The following deliverables support the broad-scale monitoring work and were co-authored by Waltz and Esch.</p> <ul style="list-style-type: none"> • Wurtzebach, Z., et al. 2019. Broader-scale Monitoring for Federal Forest Planning: Challenges and Opportunities.” <i>Journal of Forestry</i>, May 2019.

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	<ul style="list-style-type: none"> Wurtzebach, Z., et al. <i>In Press</i>. Adaptive governance and the administrative state: knowledge management for forest planning in the western United States. <i>Regional Environmental Change</i>.
Deliverable	Status
6.3) Provide website science-delivery support for ERI, SWERI, the Arizona Prescribed Fire Council (AZPFC), and 4FRI (See Project 1 for 4FRI web support).	
<p>a) <u>Deliverable</u>: Redesigned 4FRI website and website maintenance for AZPFC, SWERI, and 4FRI.</p> <p>b) <u>Deliverable</u>: Report on technical support for ERI, AZPFC, 4FRI, and SWERI websites.</p>	<p>a) 4FRI (www.4fri.org) and ERI (www.eri.nau.edu) websites were fully redesigned in FY2018. Web maintenance was performed for SWERI, ERI, 4FRI, and AZPFC sites.</p> <p>b) Web analytics can be found in the following report attachments:</p> <ol style="list-style-type: none"> i. SWERI – Project 6.3.b.i ii. ERI – Project 6.3.b.ii iii. 4FRI – Project 6.3.b.iii iv. AZPFC – Project 6.3.b.iv
Deliverable	Status
6.4) Edit and deliver biophysical and social-political-economic information for affected entities.	
<p>a) <u>Deliverable</u>: Editorial support for a total of three (3) white papers and/or working papers.</p> <p>i. White Paper that compiles the biophysical desired conditions, monitoring protocols, monitoring governance and metrics of success at achieving desired conditions of the 23 CFLR pilots (Project 1.2).</p> <p>ii. Working Paper detailing restoration prescriptions based on recommendations from best available science.</p> <p>iii. Working Paper to be defined jointly with the Southwest Fire Science Consortium.</p> <p>b) <u>Deliverable</u>: Eight (8) fact sheets and/or Topics in Restoration and Resiliency that translate and summarize scientific papers and journal articles</p>	<p>a) Report on editorial deliverables:</p> <ol style="list-style-type: none"> i) Esch, B.E., and A.E.M. Waltz. 2019. Assessing Metrics of Landscape Restoration Success in Collaborative Forest Landscape Restoration Projects. ERI White Paper. Ecological Restoration Institute, Northern Arizona University. (<i>White paper is included in this document, click here.</i>) ii) Waltz, A.E.M, M.T. Stoddard, J.P. Roccaforte, J.D. Springer, and D.W. Huffman. 2019. Restoration Prescriptions for Southwestern Frequent-Fire Adapted Forests. ERI Working Paper No. 41. Ecological Restoration Institute, Northern Arizona University. iii) Wasserman, T.N., M.T. Stoddard, A.E.M. Waltz. 2019. A Summary of the Natural Range of Variability for Southwestern Frequent-Fire Forests. ERI Working Paper No. 42. Ecological Restoration Institute, Northern Arizona University. <p>b) Eight (8) fact sheets and/or Topics in Restoration and Resiliency:</p> <ol style="list-style-type: none"> 1. Ecological Restoration Institute. 2018. What to Expect After Restoration. ERI Topics in Restoration and Resiliency. Ecological Restoration Institute, Northern Arizona University. 2. Roccaforte, J.P. 2019. Assessing Trajectories Toward Resiliency Five Years Following the Wallow Fire, Arizona. ERI Fact Sheets. Ecological Restoration Institute, Northern Arizona University. 2p. 3. Springer, J.D. 2019. Plant Community Dynamics Following Fuel Treatments and Mega-Wildfire in a Warm, Dry Mixed-Conifer Forest. ERI Fact Sheet. Ecological Restoration Institute, Northern Arizona University. 2p.

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<p>for managers (Fact Sheets) and the general public (Topics in Restoration and Resiliency).</p>	<ol style="list-style-type: none"> 4. Stoddard, M.T. 2019. Changes in Forest Dynamics 15 Years After a Wildfire in a Mountainous Ecotone, Arizona, USA. ERI Fact Sheet. Ecological Restoration Institute, Northern Arizona University. 2p. 5. Ecological Restoration Institute. 2019. What Are Restoration Treatments? ERI Topics in Restoration and Resiliency. Ecological Restoration Institute, Northern Arizona University. 2p. 6. Ecological Restoration Institute. 2019. Ecological Restoration vs. Hazardous Fuels Reduction: What's the Difference? Topics in Restoration and Resiliency. Ecological Restoration Institute, Northern Arizona University. 1p. 7. Huffman, D.W. 2019. Pinyon-Juniper Woodland Dynamics After Fuels Reduction Treatments. ERI Fact Sheet. Ecological Restoration Institute, Northern Arizona University. 2p. 8. Waltz, A.E.M. 2019. Restoration Prescriptions for Southwestern Frequent-Fire Adapted Forests. ERI Fact Sheet. Ecological Restoration Institute, Northern Arizona University.
Deliverable	Status
<p>6.5) Initiate and facilitate knowledge services and science support for non-federal entities through field trips, filling information requests, and presentations for affected entities.</p>	
<p>a) <u>Deliverable</u>: Report on actions to educate and support affected entities. Provide a minimum of ten (10) activities that may include field trips, presentations, and information requests.</p>	<p>a) Report on actions to educate and support affected entities:</p> <ul style="list-style-type: none"> • Springer, J.D. Provided technical assistance via email to Zander Evans, Forest Stewards Guild, about a question on monitoring road decommissioning. Aug. 13, 2018. <i>Information Request</i> • Springer, J.D. Provided technical assistance via email and a field trip to Glenn Rink (botanical consultant) and Julie Crawford (USFWS) on a rare plant survey. Aug. 21, 2018. <i>Information Request</i> • Vosick, D. Request for information by David Shiels, IR Consult Thalwil, Switzerland for investor information regarding 4FRI. Aug. 21, 2018. <i>Information Request</i> • Dubay, T. Aaron Livingston from the Carson NF requested photos for a slide show on prescribed fire and wildfire managed for multiple benefits. D. Huffman provided photos. Aug. 21, 2018. <i>Information Request</i> • Springer, J.D. Provided technical assistance via email to Mary Lata, Tonto NF, on a plant ID. Aug. 23, 2018. <i>Information Request</i> • Vosick, D. Request from Robin Silver, Center for Biological Diversity for Mistletoe Working Paper #39. Aug. 27, 2018. <i>Information Request</i> • Vosick, D. Panelist for a community outreach presentation and field trip discussing the Flagstaff Watershed Protection Project. Sept. 8, 2018. 25 participants. <i>Field Trip</i> • Waltz, A.E.M., and ERI staff. Field trip to Chimney Springs for the Society for Ecological Restoration. Flagstaff, AZ, 25 attendees. Sept. 14, 2018. <i>Field Trip</i> • Stotts, C.S. Presentation of restoration prescriptions and burning considerations for Festival of Science, Flagstaff, AZ, 12 attendees. Sept. 22, 2018. <i>Presentation</i>

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- Springer, J.D. Provided technical assistance via email to Deb Crisp, Coconino NF, on a rare plant question. Oct. 2, 2018. *Information Request*
- Colavito, M. and Wasserman, T. Presentation at the Society of American Foresters National Convention, Portland Oregon, Boots on the Ground Session. *Lessons Learned Communicating Science for All-Lands Planning, Coordination, and Wildfire Risk Reduction*. Oct. 5, 2018. 35 participants. *Conference Presentation*
- Vosick, D. Moderator. Society of American Foresters National Convention, Portland Oregon. *To Manage Forests or to Manage Wildfires?* Oct. 4, 2018. Approximately 500 participants. *Plenary Presentation*
- Colavito, M., and T. Wasserman. Presentation: Wildfire risk framework in Arizona-lessons learned, Society for American Foresters. Conference, Presentation, Portland, OR, 26 attendees. Oct. 6, 2018. *Presentation*
- Vosick, D. Moderator and Presenter. Society of American Foresters National Convention, Portland, Oregon. *Modernizing the Forest Service to Accelerate Landscape Scale Restoration (Interactive Discussion)*. Oct. 6, 2018. 35 participants. *Conference Presentation*
- Dubay, T., and D. Vosick. Nick Matiella with Sen. Kyl’s office requested restoration photos, which were provided. Oct. 11, 2018. *Information Request*
- Springer, J.D. Provided technical assistance via email to Hattie Braun, Coconino County Extension, with a grass ID. Oct. 12, 2018. *Information Request*
- Springer, J.D. Participated in workshop meet and greet at the Santa Rancho Ana Botanical Gardens. Oct. 13, 2018. *Workshop*
- Vosick, D. Request for Information from Tommie Martin, Gila County Supervisor about the “The Efficacy of Hazardous Fuel Treatments: A Rapid Assessment of the Economic and Ecologic Consequences of Alternative Hazardous Fuel Treatments.” Sent a link to the report and the Fact Sheet pdf. Oct. 15, 2018. *Information Request*
- Colavito, M. Request by JD Goodwin with Blue Streak Science to be interviewed in a podcast wildfire management in the western United States. Agreed to participate in the interview in April 2019. Oct. 16, 2018. *Interview Request*
- Covington, W.W. and J. Halbrosk. Presentation for Senator Kyl about Siting a Wood Utilization Business Cluster at Camp Navajo, Arizona. At Camp Navajo, Arizona followed by field trip to Fort Valley and Dry Lake Hills. Oct. 26, 2018. 25 participants. *Presentation*
- Dubay, T. Request for information about general restoration science and info on historical evidences by Scott Buffon, enviro reporter at *AZ Daily Sun*. Sent all Topics in Restoration and Resiliency papers as well as Working Paper 32 on fire regime reconstruction methods. Oct. 29, 2018. *Information Request*
- Springer, J.D. Provided technical assistance via email to Mary Lata with the Tonto NF on a plant-fire question. Oct. 30, 2018. *Information Request*

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	<ul style="list-style-type: none"> • Dubay, T., via C. Stotts. Request by Eytan Krasilovsky with the Forest Guild for copies of several ERI working and white papers to distribute at events. Papers were packaged and mailed. Nov. 5, 2018. <i>Information Request</i> • Vosick, D. “Forests, Fires and Solutions”. Presentation for visiting Indonesian land manager/ministers delegation sponsored by USFS. Flagstaff, Arizona. Nov. 7, 2018 10 Indonesian participants, 20 total people in attendance. <i>Presentation</i> • Stotts, C.S. Paper requests from Forest Stewards Guild for working papers 3, 6, 14, 18, 26, 27, 29, 34, 35, 37, and 39; and white papers 12, 13, 14, 16, 17, 18, and 21. Santa Fe, NM. Nov. 8, 2018. <i>Information Request</i> • Vosick, D., and J. Halbbrook. “Lessons Learned from 4FRI Forest Restoration.” A presentation for the New Mexico Wood Industry Summit. Ruidoso, New Mexico. November 16, 2018. 35 people in attendance. <i>Presentation</i> • Esch, B.E. Information on water and forest restoration to The Wilderness Society. Dec. 17, 2018. <i>Information Request</i> • Colavito, M., via D. Vosick and W. Covington. Request by Bruce Babbitt for map of Forest Service treatments of east side watersheds of Oak Creek. Map was produced by M. Colavito and emailed by W. Covington. Dec. 19, 2018. <i>Information Request</i> • Dubay, T. Request by Ryan Heinsius with KNAU for contacts who can speak about the government shutdown effects on forest planning and operations. Contacts, photos, and information were provided. Jan. 15, 2019. <i>Information Request</i> • Vosick, D. Interview with Sophie Quinton with the <i>Stateline News</i> service funded by the Pew Charitable Trust. Information provided about timber and acreage targets in the President’s Executive Order. Jan. 22, 2019. <i>Media Interview</i> • Springer, J.D. Provided technical assistance via email to Mary Lata, Tonto NF, about a seeding question. Feb. 26, 2019. <i>Information Request</i> • Esch, B.E. Meeting with Bowker Lab – BASI paper. Feb. 27, 2019. <i>Information Request</i> • Springer, J.D. Provided information via email about milkweed taxonomy to Mike Wagner, Milkweeds for Monarchs. March 1, 2019. <i>Information Request</i> • Vosick, D. Request for information regarding statutory changes required to address the issue of low value wood removal from Paul Summerfelt for the City of Flagstaff. March 4, 2019. <i>Information Request</i> • Vosick, D. Request by Michele Ralston, Coconino County for information on the National Forest Management Act of 1976. March 19, 2019. <i>Information Request</i> • Vosick, D. Request to visit NAU (Dendrochronology lab) by two staff members from Senator Sinema’s staff (Dan Winkler and Kate Gonzales) in order to learn more about forest restoration. March 20, 2019. 2 participants. <i>Presentation</i>
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- Vosick, D. Request by Chase Kassel, Senator McSally staff for a field tour to see forest restoration and learn about the FWPP. March 22, 2019. Approximately 25 people in attendance. *Field Trip*
- Dubai, T., via W. Covington. Jim Carlton with the *Wall Street Journal* requested a copy of the 1994 Journal of Sustainable Forestry paper, “Historical and Anticipated Changes in Forest Ecosystems of the Inland West of the United States.” April 4, 2019. *Information Request*
- Springer, J.D. Provided information via email to Jan Busco, Museum of N. Arizona, about alligator juniper. April 5, 2019. *Information Request*
- Dubai, T., via W. Covington. Interview with Andrew Nicla with *AZ Republic* on background for a story on current forest health conditions and wildfire risk across Arizona. April 12, 2019. *Media Interview*
- Waltz, A.E.M. Forest restoration, water supply resiliency, and climate change; *AZ Forward*. Flagstaff, AZ, 30 attendees. April 12, 2019. *Presentation and Field Trip*
- Springer, J.D. Provided technical assistance via email to Ken Stella, National Park Service, regarding ERI field guide and plant ID. April 18, 2019. *Information Request*
- Dubai, T. Request for handouts and materials on restoration by Morgan Andrews, an NAU senior conducting a capstone project about wildfires and home safety, for a local Wildfire Preparedness Day event. Materials were provided. April 22, 2019. *Information Request*
- Dubai, T. Request by Svea Conrad with the *AZ Daily Sun* for ERI’s perspective on forest conditions going into fire season. April 24, 2019. *Media Request*
- Vosick, D. Request by Jeff Sobatka from AZ Commerce Authority seeking contact to promote a new environmentally friendly fire retardant. Sent him to Patrick Rappold for contacts. March, 25, 2019. *Information Request*
- Vosick, D. Request by graduate students at the University of Michigan for information about past efforts to establish a restoration economy. Project is to inform the work of Wallow Enterprises. April 15, 2019. *Information Request*
- Vosick, D. Request from Tracee Sutton, staff for Congressman Stanton. Request for information about 4FRI and the RFP. April 16, 2019. *Information Request*
- Colavito, M. Request from Yeonsu Kim to lecture for her Natural Resource Policy class in the School of Forestry. May 2, 2019. *Presentation*
- Dubai, T. Request from KJZZ producer Marcus Charleston for an interview on the APS feasibility study on biomass capabilities at the Cholla Power plant. May 14, 2019. *Media Request*
- Waltz, A.E.M. Forest restoration, climate change and sustainability. Flagstaff Leadership Academy, Flagstaff, AZ, 40 attendees. May 16, 2019. *Presentation*
- Springer, J.D. Provided information via email to Julie Crawford, USFWS, on behalf of John Taylor with Terra Birds for City of Flagstaff about seeding native plants at Flagstaff City Hall. May 17, 2019. *Information Request*

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	<ul style="list-style-type: none"> • Waltz, A.E.M. Paper request from Joe Trudeau (mistletoe), tech assistance, Center for Biodiversity. May 20, 2019. <i>Information Request</i> • Springer, J.D., and D.W. Huffman. Provided information via email to Michael Remke, Mountain Studies Institute, about protocols. May 22, 2019. <i>Information Request</i> • Vosick, D., M. Colavito, J. Halbrook, and P. Rappold. Field trip support for the National Association of State Foresters. June 5, 2019. 25 Participants with State Foresters from across the United States. <i>Field Trip</i> • Vosick, D. Request for information about restoration and carbon sequestration by Keith Brekhus with Congressman O’Halloran. Finkral and Evans paper shared. June 10, 2019. <i>Information Request</i> • Vosick, D., M. Colavito, and D. Huffman. Field Tour for Gary Gold, Policy Analyst for Senator Kyrsten Sinema. June 12, 2019. <i>Field Trip</i> • Colavito, M. Presentation at the North American Forest Ecology Workshop, Flagstaff, AZ (co-developed presentation with B. Satink-Wolfson and A. Thode from SW Fire Science Consortium). <i>Using art to communicate about fire science and management in a changing climate: evaluation results from an art exhibit in Arizona</i>. June 25, 2019. 15 participants. <i>Conference Presentation</i> • Stotts, C.S., A.E.M. Waltz, H. Norton. Lead author and providing content for “web-based restoration kiosk” for the Greater Flagstaff Forest Partnership. June 27, 2019. <i>Technical Assistance</i> • Vosick, D. Field trip for Paul Chapman of Campbell Global to Gus Pearson Natural Area. June 29, 2019. <i>Field Trip</i> • Springer, J.D. Provided technical assistance via email to Mike Masek with Forager’s Path Botanical Studies regarding a plant ecology question. June 29, 2019. <i>Information Request</i> • Dubai, T. Wolfgang Grunberg from AZ Department of Forestry and Fire Management requested high-res photos contemporary doghair thicket vs healthy PiPo forests for a Story Map on the results of their 2018 Aerial Detection Survey. Photos were provided. July 1, 2019. <i>Information Request</i> • Stotts, C.S. Evidence-based restoration prescription and scaling up to tablet prescriptions for the Arizona Association of Conservation Districts, Flagstaff, AZ, 20 participants. July 10, 2019. <i>Field Trip</i> • Springer, J.D. Jonathan Long, Forest Service PSW Research Station requested a GTR review. July 17, 2019. <i>Technical Assistance</i>
<p>6.6) Educate the general public through the media.</p>	
<p>a) <u>Deliverable</u>: Two (2) newspaper articles to educate the general public about the need for forest restoration to restore frequent-fire forests.</p>	<ul style="list-style-type: none"> • Loomis, B. 2018. “Arizona’s forests are being ravaged by climate change. How much can we save?” <i>Arizona Republic</i>. August 1, 2018. • Bowling, J. 2018. “In Flagstaff, restoring forests to prevent fire and disaster.” <i>Arizona Republic</i>. August 1, 2018.

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Project 7: Duty 5 under the ACT. Provide annual progress reports.

Deliverable	Status
a) Complete annual progress report on June 30, 2019.	This final report is the deliverable for this project.