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Agricultural Experiment Station

JOHN T. HARRINGTON FORESTRY RESEARCH CENTER AT MORA

2023 ANNUAL REPORT

THE NMSU AGRICULTURAL EXPERIMENT STATION SUPPORTS RESEARCH THAT ADDRESSES REAL-WORLD PROBLEMS. RESEARCH IS AT THE CORE OF NMSU'S MISSION TO IMPROVE THE LIVES OF PEOPLE GLOBALLY.

MORAASC@NMSU.EDU
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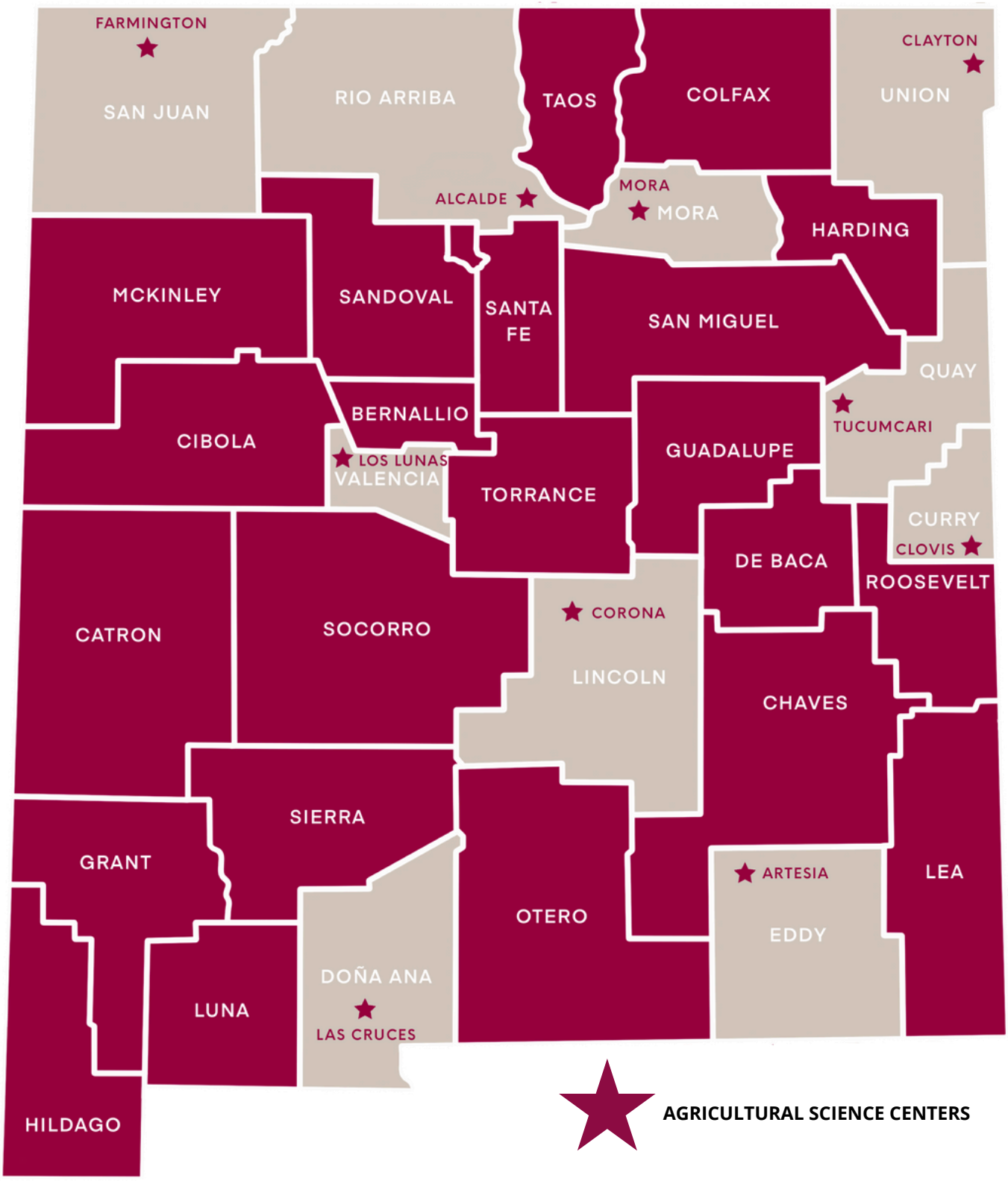
NOTICE TO USERS OF THIS REPORT

These are not formal Agricultural Experiment Station research results. Readers are cautioned against drawing conclusions or making recommendations as a result of the summaries in this report. In many instances, data represents only one of several years' results that will ultimately constitute the final formal report for a project.

None of the data are authorized for release or publication without the written prior approval of the New Mexico Agricultural Experiment Station.

Any reference in this report to any person, organization, activities, products, or services related to such person or organization is solely for informational purposes and does not constitute or imply the endorsement or recommendation of New Mexico State University or any of its employees or contractors. NMSU is dedicated to providing equal opportunities in areas of employment and academics without regard to age, ancestry, color, disability, gender identity, genetic information, national origin, race, religion, serious medical condition, sex, sexual orientation, spousal affiliation, or protected veteran status as outlined in federal and state anti-discrimination statutes. The College of Agricultural, Consumer, and Environmental Sciences is an engine for economic and community development in New Mexico. ACES academic programs help students discover new knowledge and become leaders in environmental stewardship, food and fiber production, water use and conservation, and improving the health of all New Mexicans. The College's research and extension outreach arms reach every county in the state and provide research-based knowledge and programs to improve the lives of all New Mexicans.

AGRICULTURAL SCIENCE CENTER LOCATIONS MAP



EXECUTIVE SUMMARY

New Mexico's forests supply many valuable resources to its citizens, including 50% to 75% of all water used by municipalities and agriculture. Unfortunately, forest health in New Mexico and the entire western U.S. is declining due to a combination of factors that include historic fire suppression, increased fuel densities, increased drought, and a lack of proper forest management. As a result of these factors, the dense forests of the Southwest are experiencing some of the most destructive wildfires in history. This trend will likely continue into the near future. Many of the forests that have succumbed to high-severity fires are not regenerating naturally resulting in a loss of forests. Therefore, it is critical to invest in the reforestation pipeline effort (seed, nursery, and planting) for the state and region that will help to benefit forest health, water quality and quantity, carbon sequestration, wildlife habitat, recreation, and many other valuable resources.

The New Mexico Reforestation Center (NMRC) is currently under development and will serve to fill the gaps in the reforestation pipeline, emphasizing both scale and urgency, in the southwestern US while serving as a model for other regions. NMRC's mission is to meet current and future regional reforestation needs through its comprehensive seed bank, nursery, and planting operations combined with research, education, and outreach activities. In 2023, a formal agreement between the USDA Forest Service and the NMRC (via NMSU) was established to address the growing reforestation needs in the region utilizing the expertise and resources of the NMRC. Additionally, in 2023, the NMRC (with NMSU acting as the fiscal agent) received $18.5 million in state and federal funding to support the initial design and construction of the reforestation facility which will be located at the JTH Forestry Research Center in Mora, NM.

The JTH Forestry Research Center (JTH FRC) will continue to operate as normal in parallel with the activities and efforts of the NMRC. Research in reforestation is critical to continued success. Science-based reforestation has the single greatest potential for climate change mitigation compared to all other land management activities. However, the backlog of reforestation needs across the United States continues to grow each year in direct response to disturbances such as those caused by fire, insects, and disease. This growing backlog has recently generated significant momentum to improve national reforestation efforts as seen by initiatives such as the REPLANT and Executive Order No. 14072. With massive reforestation actions on the horizon, it is critical to implement climate-smart reforestation that addresses how trees are planted for future climatic conditions. *(continues on next page)*

EXECUTIVE SUMMARY

The climate is changing faster than trees can migrate and/or adapt through both natural regeneration and conventional tree planting practices. Therefore, it is fundamental that researchers understand how to build climate resiliency for future forests by examining genetic sources, nursery cultural practices, and planting methods that influence morphological and physiological traits that promote tolerance to drought, heat, insect, and other stress factors that ultimately lead to greater seedling survival after planting.

Currently, the JTH FRC is the only program in the four corner states (NM, UT, AZ, and CO) focusing research efforts along the entire reforestation pipeline. It is also only one of five programs in the entire country dedicated to researching the reforestation pipeline, making it extremely competitive to respond to reforestation challenges, locally and nationally. In 2023, the JTH FRC produced 2 publications addressing: 1) drought conditioning influences on ponderosa pine physiology and morphology and 2) co-planting nitrogen-fixing host trees to facilitate forest regeneration of sandalwood. Research continues to focus on critical topics such as assisted migration and seed transfer guidelines in response to climate change, seedling-based aspen restoration, planting strategies that promote long-term improvements to water resources, and drought-conditioning seedlings during nursery products.

RESEARCH HIGHLIGHTS

EVALUATING VEGETATION CONTROL AND ANIMAL PROTECTION MEASURES FOR POST-FIRE REFORESTATION OF PONDEROSA PINE

Investigators: Dr. Owen Burney (oburney@nmsu.edu) and Dr. Joshua Sloan

PROJECT OVERVIEW

The focus of this study is to compare planted ponderosa pine seedlings under an interaction of animal protection methods (fencing and tree shelters) and vegetation management intensities (none, partial, complete control) to improve reforestation success. Additionally, this research will examine the cost-effectiveness of these treatments.

MEETING THE NEEDS OF NEW MEXICO

This research will benefit all communities of New Mexico due to the added value it has on many ecosystem services that reforestation has on water, recreation, wildlife, timber, and many other valuable resources.

IMPACT

Results from this research are and will continue to be used to inform land managers throughout the western US on reforestation strategies that improve seedling survival and growth.

FUNDING ACKNOWLEDGMENT:

NSF/CREST

OPTIMIZING OUT PLANTING STRATEGIES OF PONDEROSA PINE IN A POST-FIRE ENVIRONMENT THROUGH SEEDLING SIZE, PLANTING WINDOWS, AND NURSERY CONDITIONING

Investigators: Dr. Owen Burney (oburney@nmsu.edu) and Dr. Joshua Sloan

PROJECT OVERVIEW

The focus of this study is to optimize seedling performance by comparing stock size (10 and 30 cubic-inch containers), planting window (summer, fall, spring), and use of drought condition treatments in the nursery.

MEETING THE NEEDS OF NEW MEXICO

This research will benefit all communities of New Mexico due to the added value it has on many ecosystem services that reforestation has on water, recreation, wildlife, timber, and many other valuable resources.

IMPACT

Results from this research are and will continue to be used to inform land managers throughout the western US on reforestation strategies that improve seedling survival and growth.

FUNDING ACKNOWLEDGMENT:
NSF/CREST

USING NUCLEATION PLANTING STRATEGIES FOR PONDEROSA PINE POST-FIRE REFORESTATION

Investigators: Dr. Owen Burney (oburney@nmsu.edu), Dr. Joshua Sloan, and Dr. Aslap Dixit

PROJECT OVERVIEW

The short-term objective (0 – 5 years) is to understand what combination of nucleation size and planting density promotes greater survival and growth for individual ponderosa pine seedlings. The long-term objective (10 – 30 years) is to determine which treatment combination will result in a rapid expansion from each nucleus.

MEETING THE NEEDS OF NEW MEXICO

This research will benefit all communities of New Mexico due to the added value it has on many ecosystem services that reforestation has on water, recreation, wildlife, timber, and many other valuable resources.

IMPACT

Results from this research are and will continue to be used to inform land managers throughout the western US on reforestation strategies that improve seedling survival and growth.

FUNDING ACKNOWLEDGMENT:

NSF/CREST

ASSESSING LOG AND SNAG MICROSITES FOR REFORESTATION OF ASPEN IN A POST-FIRE ENVIRONMENT

Investigators: Dr. Owen. Burney (oburney@nmsu.edu), Dr. Karen Mock, and Dr. Larissa Yocom (PI) (Larissa.yocom@usu.edu)

PROJECT OVERVIEW

The focus of this study is to understand the influence of log and snag microsites (i.e., soil moisture, shading, etc.) on out-planted aspen seedling performance.

MEETING THE NEEDS OF NEW MEXICO

This research will benefit all communities of New Mexico due to the added value it has on many ecosystem services that reforestation has on water, recreation, wildlife, timber, and many other valuable resources.

IMPACT

Results from this research are and will continue to be used to inform land managers throughout the western US on reforestation strategies that improve seedling survival and growth.

FUNDING ACKNOWLEDGMENT:

NSF/CREST, USDA McIntire Stennis

PHYSIOLOGICAL AND MORPHOLOGICAL RESPONSES OF PINUS PONDEROSA SEEDLINGS TO MOISTURE LIMITATIONS IN THE NURSERY AND THEIR IMPLICATIONS FOR RESTORATION

Investigators: Dr. Owen Burney (oburney@nmsu.edu), Dr. Joshua Sloan, and Dr. Jeremy Pinto (PI)

PROJECT OVERVIEW

The objective of this study was to examine the effects of reduced water delivery during the nursery growth phase on the structure and function of P. ponderosa to improve survival and growth on dry, harsh out-planting sites. Additionally, this study assessed, to a limited extent, the potential interactions between seed source (i.e., genetic influence) and water limitations during nursery production (i.e., environmental influence).

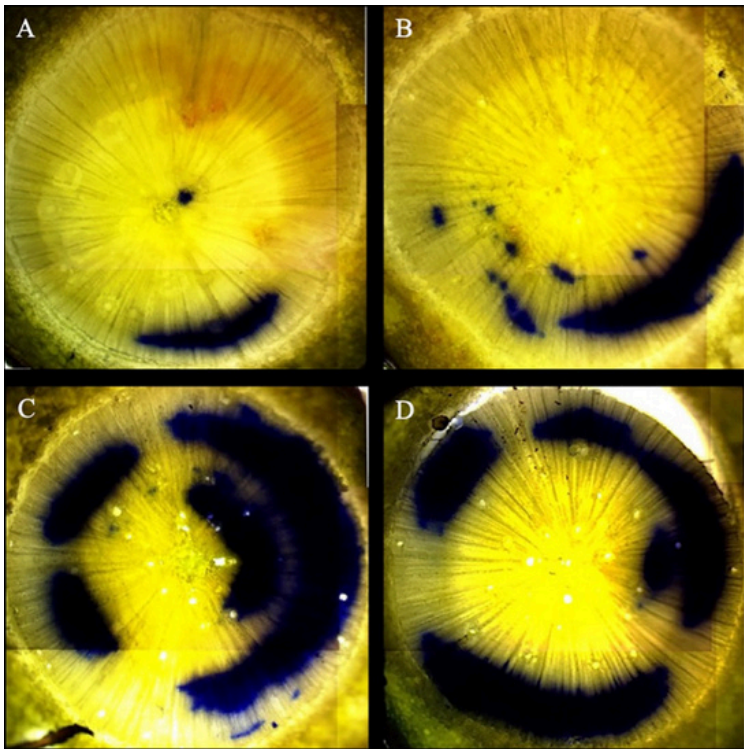
MEETING THE NEEDS OF NEW MEXICO

This research will benefit all communities of New Mexico due to the added value it has on many ecosystem services that reforestation has on water, recreation, wildlife, timber, and many other valuable resources.

IMPACT

Results from this research are and will continue to be used to inform land managers throughout the western US on reforestation strategies that improve seedling survival and growth.

FUNDING ACKNOWLEDGMENT:
USDA McIntire Stennis



INFLUENCE OF POST-FIRE SNAGS ON MICROSITE PLANTING ENVIRONMENTS

Investigators: Dr. Owen Burney (oburney@nmsu.edu), Dr. Simon Landhäusser (PI), and Dr. Charles Nock

PROJECT OVERVIEW

The main objective of this study is to determine if residual stems in burned forested landscapes influence regeneration efforts via tree planting. Specific objectives include: 1) determining if snags aid in soil moisture concentration through stemflow, 2) the impacts of stemflow on planted aspen, and 3) determining stem flow patterns in relation to weather events.

MEETING THE NEEDS OF NEW MEXICO

This research will benefit all communities of New Mexico due to the added value it has on many ecosystem services that reforestation has on water, recreation, wildlife, timber, and many other valuable resources.

IMPACT

Results from this research are and will continue to be used to inform land managers throughout the western US on reforestation strategies that improve seedling survival and growth.

FUNDING ACKNOWLEDGMENT:
NSF/CREST, USDA McIntire Stennis

DEVELOPING CARBON SEQUESTRATION MODELS FOR POST-FIRE REFORESTATION EFFORTS IN THE SOUTHWESTERN US

Investigators: Dr. Owen Burney (PI) (oburney@nmsu.edu), Dr. Chris Marsh, Dr. Matthew Hurteau, and Dr. Doug Cram

PROJECT OVERVIEW

Given the outsized role forests play in helping to regulate the climate, reforesting severely disturbed areas, such as post-fire environments, has the potential to increase carbon sequestration. However, there is a lack of information regarding how to best calculate the amount of carbon that is being sequestered in reforestation activities. The main objective of this study will be to develop a baseline model for calculating carbon storage of recently planted ponderosa pine (*Pinus ponderosa var. scopulorum*) across the greater southwestern US region.

MEETING THE NEEDS OF NEW MEXICO

This research will benefit all communities of New Mexico due to the added value it has on many ecosystem services that reforestation has on water, recreation, wildlife, timber, and many other valuable resources.

IMPACT

Results from this research are and will continue to be used to inform land managers throughout the western US on reforestation strategies that improve seedling survival and growth.

FUNDING ACKNOWLEDGMENT:
NSF/CREST, USDA McIntire Stennis

FOREST REGENERATION DYNAMICS IN RESPONSE TO PLANTING DENSITY, MULCH, AND FERTILIZER IN GEORGIA'S MARITIME FORESTS

Investigators: Dr. Owen Burney (oburney@nmsu.edu) and Dr. Douglass Jacobs

PROJECT OVERVIEW

Maritime forests are important coastal ecosystems that stabilize coastlines, recharge aquifers, and protect us from storm surges. The range of these forests has been decreasing due to threats such as urban expansion, clearing for agriculture, climate change, and an influx of native loblolly pine (*Pinus taeda L.*) from pine plantations. To restore maritime forests, we need to restore southern live oak (*Quercus virginiana Mill.*) as the dominant canopy species however, studies on how to grow live oak in a restoration setting are limited. We planted 720 southern live oak seedlings in a 0.61 Hectare clearcut that was historically a loblolly pine plantation. Our goal was to test how planting density (1-meter, 2-meters, 3-meters), mulch (yes or no), and fertilizer (yes or no) impacted the initial growth of these seedlings over the course of four growing seasons.

MEETING THE NEEDS OF NEW MEXICO

This research expands the visibility of NMSU and the JTH FRC in Mora. As a result, national and global recognition as forest restoration experts will provide added value to all forest restoration efforts conducted in New Mexico.

IMPACT

Results from this research are and will continue to be used to inform land managers throughout the western US on reforestation strategies that improve seedling survival and growth.

FUNDING ACKNOWLEDGMENT:
USDA McIntire Stennis

CO-PLANTING OF A FAST-GROWING NITROGEN-FIXING HOST TREE FACILITATES REGENERATION OF THE ROOT HEMIPARASITIC ‘ILIAHI (HAWAIIAN SANDALWOOD)

Investigators: Dr. Emily Thyroff (PI), Dr. Owen Burney (oburney@nmsu.edu), and Dr. Douglass Jacobs

PROJECT OVERVIEW

Santalum sandalwood species, including the endemic Hawaiian species known as ‘iliahi (*Santalum paniculatum*), are ecologically distinct as root hemiparasitic, evergreen trees requiring suitable hosts for long-term resource acquisition. Restoration and sustainable forestry of ‘iliahi at degraded sites, including threatened tropical dry forests, therefore, require supporting host plant populations. The objective of this research compared host dynamics for ‘iliahi with different hosts at different planting distances. ‘Iliahi grew more when paired with koa (*Acacia koa*) at a close distance than with ‘a‘ali‘i (*Dodonaea viscosa*) at any distance or the control with no host. After three years, survival of ‘iliahi seedlings was greatest for ‘iliahi paired with koa at 1.0 m (88 %) compared to the control with no host (53 %) and when paired with koa at 2.0 m (55 %).

MEETING THE NEEDS OF NEW MEXICO

This research expands the visibility of NMSU and the JTH FRC in Mora. As a result, national and global recognition as forest restoration experts will provide added value to all forest restoration efforts conducted in New Mexico.

IMPACT

Results from this research are and will continue to be used to inform land managers throughout the western US on reforestation strategies that improve seedling survival and growth.

FUNDING ACKNOWLEDGMENT:
USDA McIntire Stennis

PINUS PONDEROSA CARBON MODELING AND PROVENANCE TEST

Investigators: Dr. Owen Burney (PI) (oburney@nmsu.edu) and Dr. Aalap Dixit

PROJECT OVERVIEW

The climate is changing faster than trees can migrate and/or adapt through both natural regeneration and conventional tree planting practices (Williams & Dumroese, 2013). Therefore, it is fundamental that researchers understand how to build climate resiliency for future forests through the establishment of a network of provenance and common garden tests that will examine a range of genetic sources for traits that increase the potential for genetic diversity and adaptability. These tests will inform seed source selections to promote long-term reforestation success. The objective of this study is to assess the effects of climatic changes across 75 sources of ponderosa pine on survival, growth, physiological parameters, and carbon sequestration over 10 years of growth

MEETING THE NEEDS OF NEW MEXICO

This research will benefit all communities of New Mexico due to the added value it has on many ecosystem services that reforestation has on water, recreation, wildlife, timber, and many other valuable resources

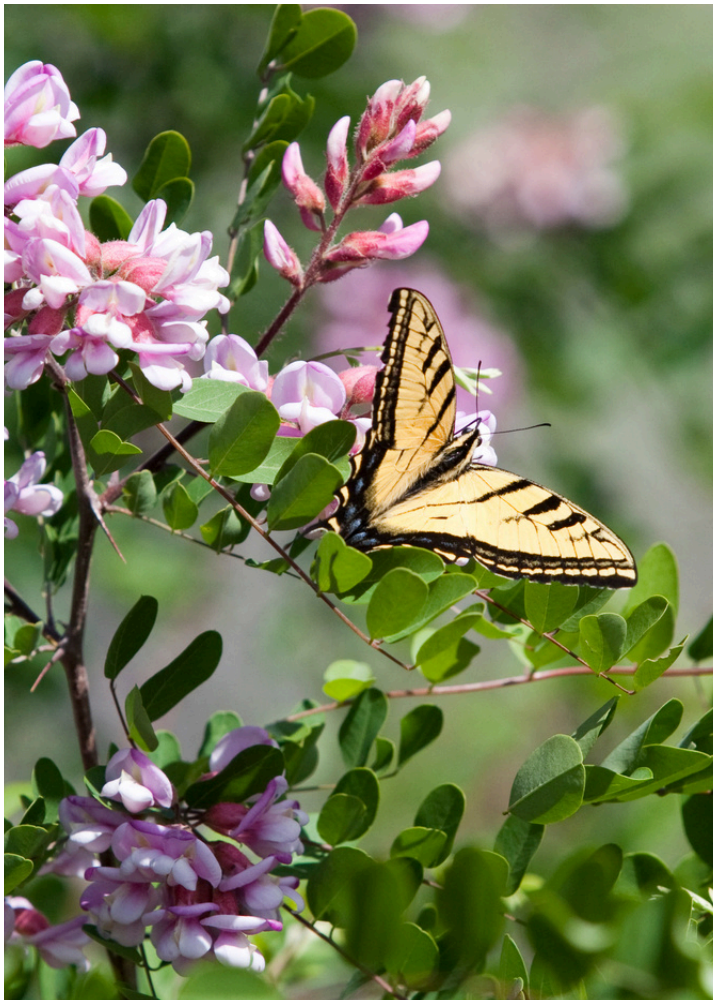
IMPACT

Results from this research are and will continue to be used to inform land managers throughout the western US on reforestation strategies that improve seedling survival and growth

FUNDING ACKNOWLEDGMENT:

USDA McIntire Stennis

BY THE NUMBERS



RESEARCH PUBLICATIONS

- Pinto JR, Sloan JL, Ervan G, **Burney OT** (2023) Physiological and morphological responses of *Pinus ponderosa* seedlings to moisture limitations in the nursery and their implications for restoration. Frontiers in Plant Science, doi.org/10.3389/fpls.2023.1127656

- Thyroff EC, Rose KME, Idol TW, Moon Q, **Burney OT,** Jacobs DF (2023) Co-planting of a fast-growing nitrogen-fixing host tree facilitates regeneration of the root hemiparasitic ʻiliahi (Hawaiian sandalwood). *Forest Ecology and Management*, doi.ogr/10.1016/j.foreco.2023.121084

GRANTS AND CONTRACTS

NUMBER OF PROPOSALS SUBMITTED FOR 2023: 4
FUNDS REQUESTED FOR 2023: $20,059,887
FUNDS AWARDED FOR 2023: $20,059,887
GRANT EXPENDITURES FOR 2023:$1,139,633

- CREST Center for Forest Restoration Triangle; Sponsor: NSF; Amount: $1,057,671; Status: Funded; Burney, O. (Principal); (December 2019 – December 2024).

- Construction of the New Mexico Reforestation Center (Phase 1 and 2a); Sponsor: USDA Forest Service, State of New Mexico; Amount: $18,500,000; Status: Funded; Burney, O. (Co-Principal), Hurteau, M. (Co-Principal), Sloan, J. (Co-Principal), McCarthy, L. (Co-Principal) (Varied through 2023 – end date under discussion)

- New Mexico Reforestation Center Planting Program; Sponsor: Congressionally Directed Spending, Heinrich and Lujan; Amount: $1,200,000; Status: Funded; Burney, O. (Principal) (July 2023 – June 2026)

- Building Forest Seedling Nursery Capacity in New Mexico; Sponsor: USDA Forest Service; Amount: $160,000; Status: Funded; Burney, O. (Principal); (October 2023 – September 2026)

- Tree Improvement and Forestation Plan; Sponsor: NM Energy, Minerals, and Natural Resources Department; Amount: $8,000; Status: Funded; Burney, O. (Principal); (July 2021 - June 2022)

- Seedling Conservation for EMNRD Forestry Division; Sponsor: NM Energy, Minerals, and Natural Resources Department; Amount: $91,028; Status: Funded; Burney, O. (Principal); (December 9, 2021 - March 31, 2023)

- Improving Climate Resilience Through Carbon Management and Soil Health Research, Outreach, and Education Activities; Sponsor: Congressionally Directed Spending, Heinrich and Lujan; Award: $995,000; Co-PI Award: $100,859; Current Status: Funded; Burney, O. (Co-Principal), Ghimire, R. (Principal), other NMSU faculty; (October 1, 2022 - September 30, 2024)

- McIntire Stennis; Sponsor: USDA Forest Service; Amount: $30,000; Status: Funded; Burney, O. (Principal); (October 2022 – September 2023)

- Colorado Reforestation; Sponsor: TNC; Amount: $16,398; Status: Funded; Burney, O. (Principal); (January 1, 2023 – December 31, 2023)

- Hermits Peak / Calf Canyon Reforestation Training; Sponsor: NM Highlands University; Amount: $13,694; Status: Funded; Burney, O. (Principal); (January 1, 2023 – December 31, 2023)

OUTREACH ACTIVITIES

FORESTRY DAY:

The JTH Forestry Research Center hosted a forestry day for the public to discuss the importance of forest restoration. Additionally, the Trambley family was honored for opening up their land in 1972 to New Mexico State University, to this research center, and for the benefit of all of us. Approx. 100 people in attendance. (June 14, 2023)

Frank C. Trambley (1928-2015)
Delicia T. Trambley (1931-2015)

2023 FIELD DAY

JUNE 14TH

PEOPLE

COOPERATORS AND COLLABORATORS

OTHER UNIVERSITIES

- New Mexico Highlands University
- Utah State University
- Colorado State University
- Purdue University
- Northern Arizona University
- University of New Mexico
- University of Hawai'i
- University of Alberta

STATE OF NEW MEXICO

- New Mexico Forest and Watershed Restoration Institute
- State Forestry Division, New Mexico EMNRD

FEDERAL AGENCIES

- National Park Service
- US Forest Service
- US Geological Survey

NON-GOVERNMENT ORGANIZATIONS

- Institute of Applied Ecology
- Philmont Scout Ranch – Boy Scouts of America
- The Nature Conservancy
- International Union of Forest Research Organizations

TRIBAL

- Santa Clara Pueblo
- Jemez Pueblo

INDUSTRY/PRIVATE

- Imerys Minerals

ADVISORY COMMITTEE

- Owen Burney, New Mexico State University
- Josh Sloan, New Mexico Highlands University
- Alan Barton, NM Forest & Watershed Restoration Institute
- Matt Piccarello, The Nature Conservancy
- Linda Nagel, Utah State University
- Lindsay Quam, NM State Forestry Division
- Daniel Denipah, Santa Clara Pueblo
- Jim Youtz, USDA Forest Service
- Eytan Krasilovsky, Forest Stewards Guild

GRADUATE STUDENTS

- Skyler Roe – NMSU (graduated Spring 2023)
- Dilshad Safiullah – NM Highlands University (current)
- Sarah Kapel – Utah State University (current)
- Gohkan Ervan – NMSU (graduated Spring 2018) – assisted with publication in 2023
- Alex Britz – University of Alberta (current)
- Brianne Innusa – Purdue University (current)
- Emily Thyroff – University of Hawai'i (graduated Spring 2023)
- Dillon Alexander – NM Highlands University (current)
- Brianne Innusa – Purdue University (current)

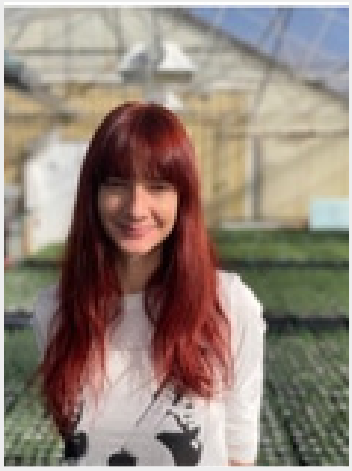
ASC PERSONNEL

DR. OWEN BURNEY

Professor and ASC Director

TAMMY PARSONS

Nursery Manager



POULI SIKELIANOS

Research Assistant

JOSH TRUJILLO

Ag Science Center Laborer

DONNA EBLER

Fiscal Assistant

MARISOL MARTINEZ

Student Intern

ISABELLA MARTINEZ

Student Intern