



JOHN T. HARRINGTON FORESTRY RESEARCH CENTER AT MORA

NMSU
STATE

Notice to Users of This Report

This report has been prepared by Science Center staff to document the results of the various research projects from the past year and to record data for future reference. These are not formal Agricultural Experiment Station Report research results, and the reader is cautioned against drawing conclusions or making recommendations as a result of data in this report. In many instances, data represents only one of several years' results that will constitute the final formal report. Although staff members have made every effort to check the accuracy of the data presented, this report was not prepared as a formal release. None of the data is authorized for release or publication, without the written prior approval of the NMSU Agricultural Experiment Station.

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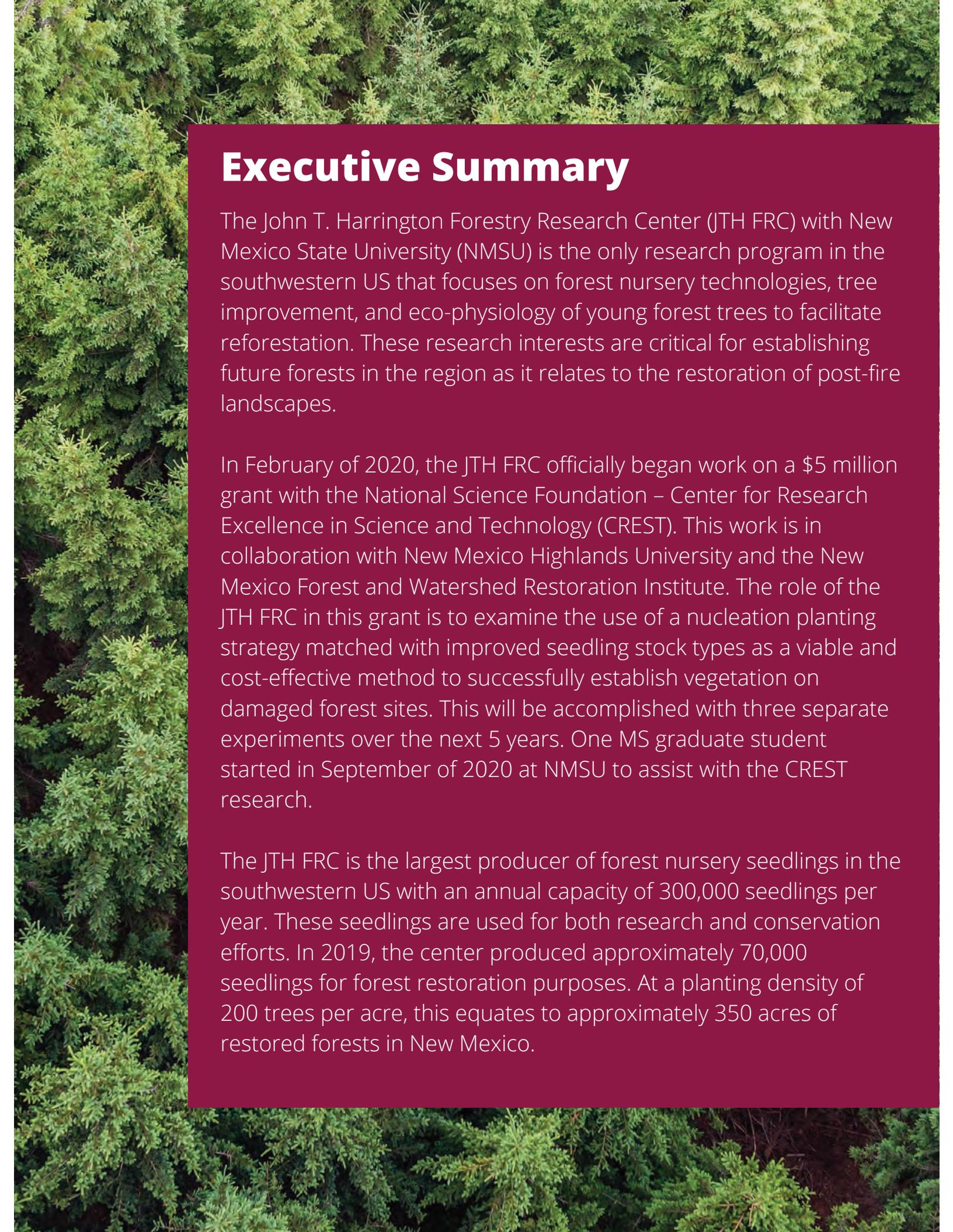


Conversion Table for English and Metric (SI) Units

The following conversion table is provided as an aid for those who may wish to convert data appearing in this report from English (U.S.) units to Metric (SI) units, or vice versa. (Calculations are approximations only.)

To convert English to Metric, multiply by	English (U.S.) units	Metric (SI) units	To convert Metric to English, multiply by
2.540	inches (in)	centimeters (cm)	0.394
0.305	feet (ft)	meters (m)	3.281
1.609	miles (miles)	kilometers (km)	0.621
0.093	square feet (ft ²)	square meters (m ²)	10.764
2.590	square miles (mile ²)	square kilometers (km ²)	0.386
0.405	acres (ac)	hectares (ha)	2.471
28.350	ounces (oz)	grams (g)	0.035
29.574	fluid ounces (fl oz)	milliliters (mL)	0.034
3.785	gallons (gal)	liters (L)	0.264
0.454	pounds (lbs)	kilograms (kg)	2.205
907.185	ton (2000 lbs) (t)	kilograms (kg)	0.001
0.907	ton (2000 lbs) (t)	metric tonnes (t) or Megagrams (Mg)	1.102
1.000	parts per million (ppm)	ppm (mg/kg)	1.000
1.121	pounds/acre (lbs/ac)	kilograms/hectare (kg/ha)	0.892
2.240	tons/acre (t/ac)	Megagrams/hectare (Mg/ha)	0.446
16.018	pounds per cubic feet (lbs/ft ³)	kilograms per cubic meter (kg/m ³)	0.062
0.070	cubic feet/acre (ft ³ /ac)	cubic meters/hectare (m ³ /ha)	14.291
73.078	ounces/acre (oz/ac)	milliliters/hectare (mL/ha)	0.014
62.710	bushels/acre (corn: 56# bu)	kilograms/hectare (kg/ha)	0.016
67.190	bushels/acre (wheat: 60# bu)	kilograms/hectare (kg/ha)	0.015
125.535	Cwt/acre (100 wt)	kilograms/hectare (kg/ha)	0.008
0.042	Langleys (Ly)	Megajoules (MJ)/m ²	23.900
(°F-32)÷1.8	Fahrenheit (°F)	Celsius (°C)	(°C x 1.8) + 32

For additional helpful English-Metric conversions, see: <https://www.extension.iastate.edu/agdm/wholefarm/html/c6-80.html> and <https://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/null/?cid=stelprdb1043619>

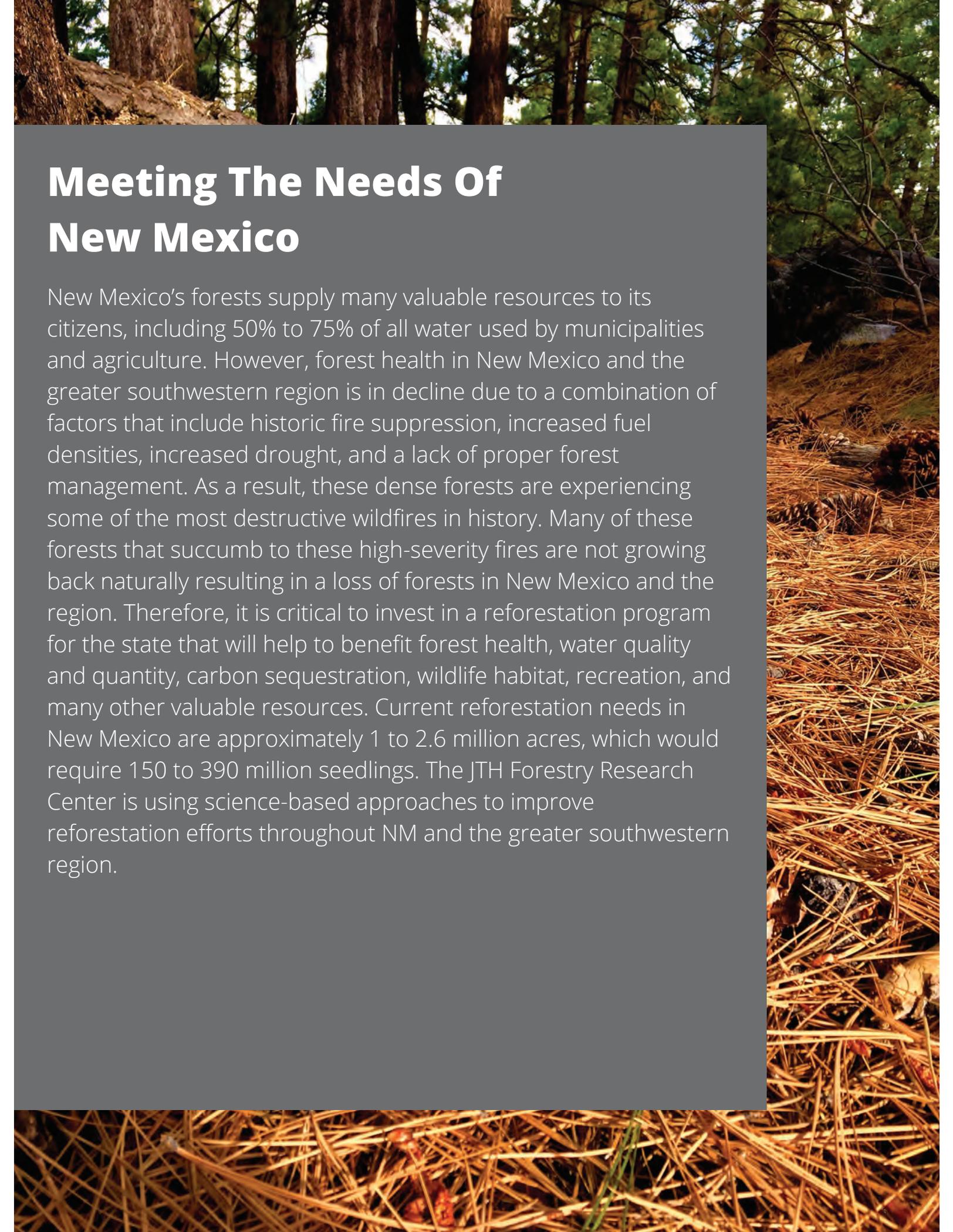


Executive Summary

The John T. Harrington Forestry Research Center (JTH FRC) with New Mexico State University (NMSU) is the only research program in the southwestern US that focuses on forest nursery technologies, tree improvement, and eco-physiology of young forest trees to facilitate reforestation. These research interests are critical for establishing future forests in the region as it relates to the restoration of post-fire landscapes.

In February of 2020, the JTH FRC officially began work on a \$5 million grant with the National Science Foundation – Center for Research Excellence in Science and Technology (CREST). This work is in collaboration with New Mexico Highlands University and the New Mexico Forest and Watershed Restoration Institute. The role of the JTH FRC in this grant is to examine the use of a nucleation planting strategy matched with improved seedling stock types as a viable and cost-effective method to successfully establish vegetation on damaged forest sites. This will be accomplished with three separate experiments over the next 5 years. One MS graduate student started in September of 2020 at NMSU to assist with the CREST research.

The JTH FRC is the largest producer of forest nursery seedlings in the southwestern US with an annual capacity of 300,000 seedlings per year. These seedlings are used for both research and conservation efforts. In 2019, the center produced approximately 70,000 seedlings for forest restoration purposes. At a planting density of 200 trees per acre, this equates to approximately 350 acres of restored forests in New Mexico.



Meeting The Needs Of New Mexico

New Mexico's forests supply many valuable resources to its citizens, including 50% to 75% of all water used by municipalities and agriculture. However, forest health in New Mexico and the greater southwestern region is in decline 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, these dense forests are experiencing some of the most destructive wildfires in history. Many of these forests that succumb to these high-severity fires are not growing back naturally resulting in a loss of forests in New Mexico and the region. Therefore, it is critical to invest in a reforestation program for the state that will help to benefit forest health, water quality and quantity, carbon sequestration, wildlife habitat, recreation, and many other valuable resources. Current reforestation needs in New Mexico are approximately 1 to 2.6 million acres, which would require 150 to 390 million seedlings. The JTH Forestry Research Center is using science-based approaches to improve reforestation efforts throughout NM and the greater southwestern region.

Mission

The center aims to advance the understanding of the effects of restoration activities on forested areas in New Mexico through multidisciplinary research, education, and stakeholder collaborations. It also will provide science-based solutions for private, tribal, state, and federal forest managers, who face the threat of catastrophic fires due to overgrown forests and the inability of post-fire plant communities and ecosystems to naturally regenerate after such fires.





JTH FORESTRY RESEARCH CENTER

Since the inception of the JTH FRC, forest health in New Mexico and the entire southwestern US has continued to decline 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, forests of the southwestern US have been burning at catastrophic levels, especially in recent years. The effects of these fires influence downstream water sources (municipal and agricultural), forest-stocking levels, wildlife habitat, and many other critical resources.

Reforestation of these severely burned forest lands is not commonly practiced in the southwest primarily due to a lack of knowledge and resources. For those areas that have been reforested, there has been little success with an average of only 20% survival of planted seedlings. It is critical to promote applied research that will address these forest health concerns including forest restoration and reforestation.

Agricultural Experiment Station

What Is the Agricultural Experiment Station?

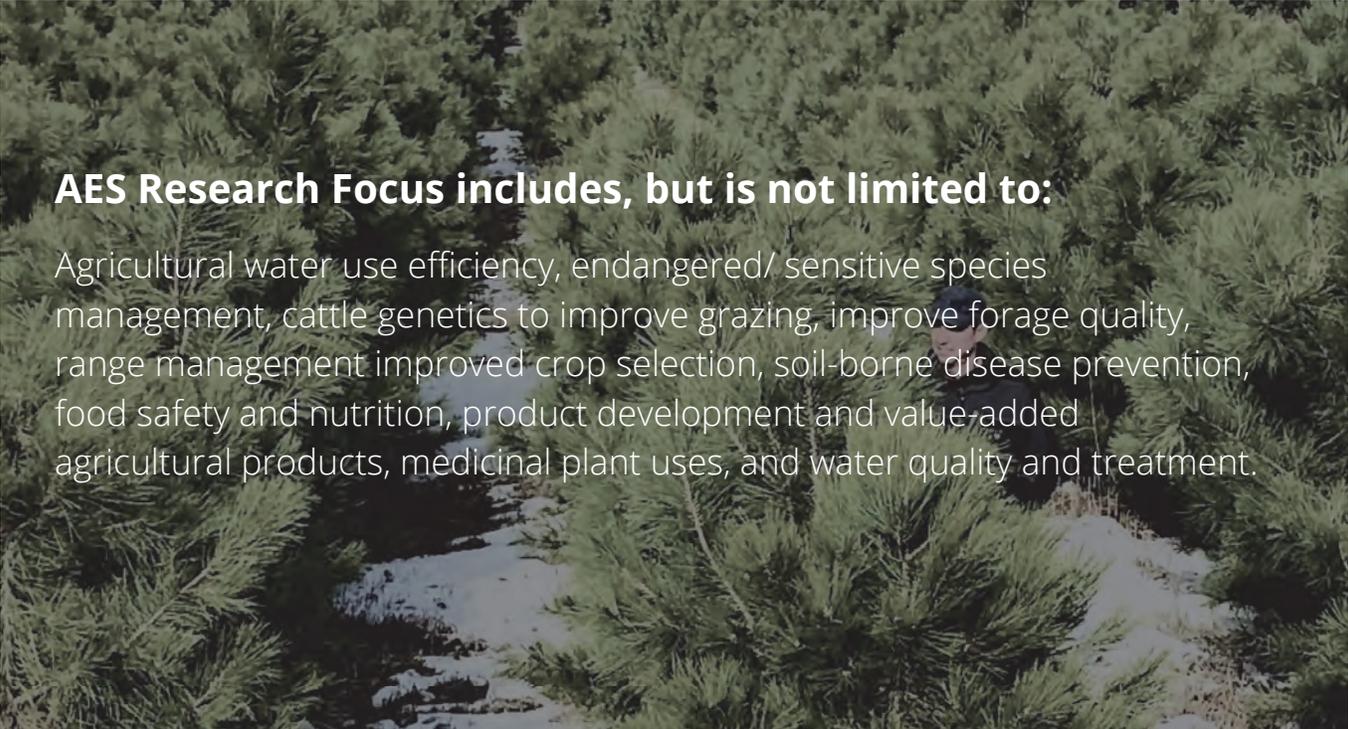
NMSU's Agricultural Experiment Station is the principal research unit of the College of Agricultural, Consumer and Environmental Sciences. All research faculty in the college have appointments in the Agricultural Experiment Station.

Mission

The Agricultural Experiment Station is not a physical site, but rather a system of scientists who work on facilities on the main campus in Las Cruces and at 12 agricultural science and research centers located throughout the state. The Agricultural Experiment Station system also interacts with other university research units and various state and federal agencies to provide opportunities for research that will benefit the citizens of New Mexico.

The Agricultural Experiment Station supports research designed to:

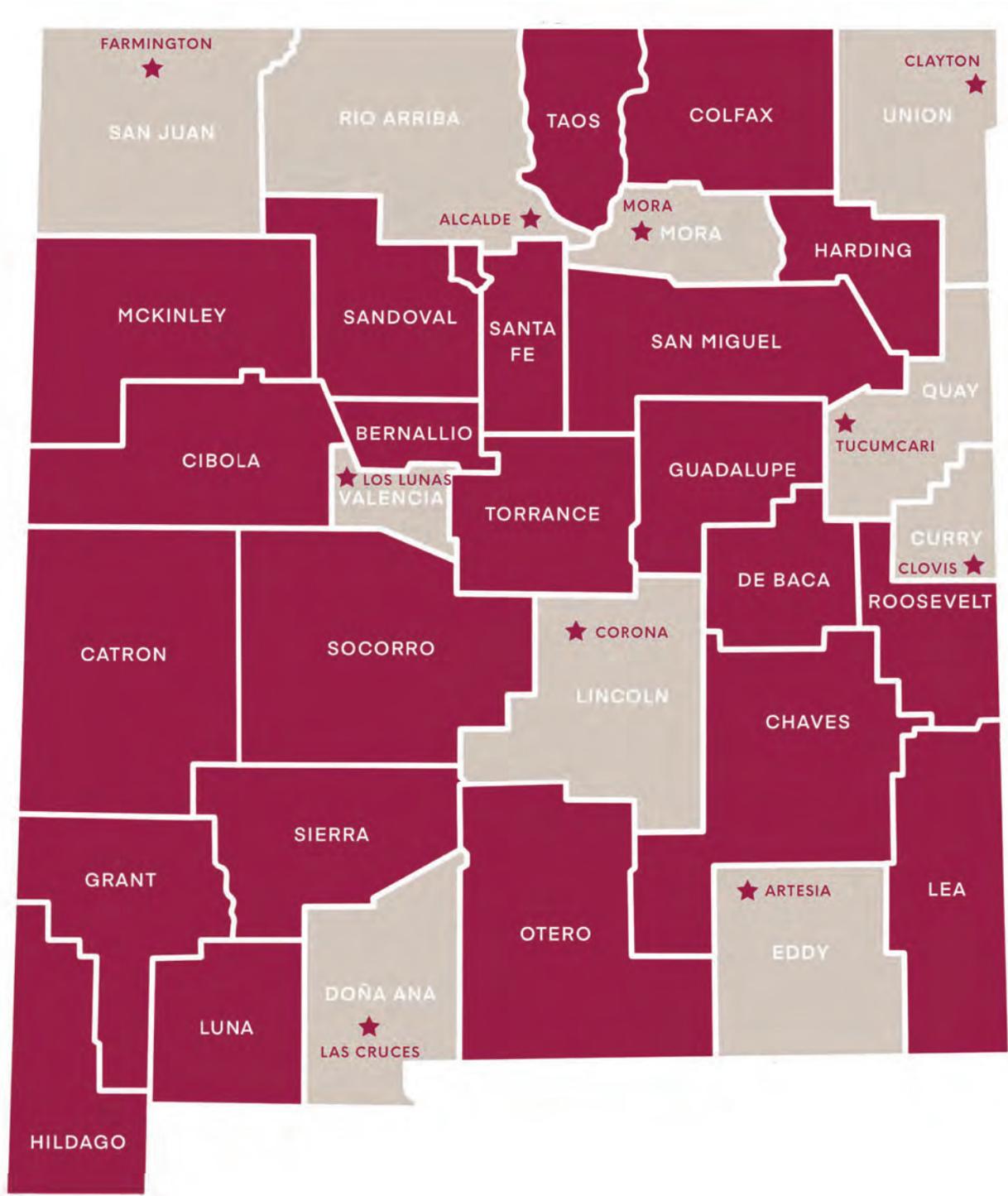
- Enhance agricultural profitability.
- Stimulate economic development using natural resources.
- Improve the quality, safety and reliability of food and fiber products.
- Sustain and protect the environment with ecologically sound practices.
- Manage and protect natural resources.
- Improve the quality of life for the people of New Mexico.



AES Research Focus includes, but is not limited to:

Agricultural water use efficiency, endangered/ sensitive species management, cattle genetics to improve grazing, improve forage quality, range management improved crop selection, soil-borne disease prevention, food safety and nutrition, product development and value-added agricultural products, medicinal plant uses, and water quality and treatment.

NMSU Agricultural Experiment Station



★ Station Locations

John T. Harrington Forestry Research Center

Faculty and Staff

Owen Burney, Ph.D.
*Associate Professor
and Director*

Juliet Smith, B.S.
Research Assistant

Tammy Parsens
Nursery Manager

Josh Trujillo
*Ag Science Center
Laborer*

Jerod Shipley
Ag Science Center Laborer

Cooperators/Collaborators

1. New Mexico Highlands University
2. New Mexico Forest and Watershed Restoration Institute
3. State Forestry Division, New Mexico EMNRD
4. Utah State University
5. Purdue University
6. Northern Arizona University
7. University of New Mexico
8. The Nature Conservancy
9. National Park Service
10. US Forest Service
11. US Geological Survey
12. Institute of Applied Ecology
13. International Union of Forest Research Organizations
14. Santa Clara Pueblo
15. Imerys Minerals
16. Philmont Scout Ranch – Boy Scouts of America

Mora Research Center

Fiscal Year: 2020
Fiscal Period: 30-Jun-20

Department	Acct Type	Account Index Desc	Revenue YTD	Expense Budget	Expense YTD	Budget Balance Available YTD	Fund Balance Dr/(Cr)
Mora Research Center	CREST CENTER FOR FOREST RESTORATION	CREST CENTER/FOREST RESTORATION		\$279,297.00	\$0.00	\$279,297.00	
Mora Research Center	DEFINING SEED TRANSFER GUIDELINES	DEFINING SEED TRANSFER GUIDELINES		\$19,739.14	\$5,086.98	\$14,652.16	
Mora Research Center	PROJECT 877	TREE IMPROVEMENT/FORESTATION 17/18		\$8,000.00	\$0.00	\$8,000.00	
Mora Research Center	PROJECT 877	TREE IMPROVEMENT/FORESTATION 18/19		\$8,000.00	\$0.00	\$8,000.00	
Mora Research Center	SEEDLING PRODUCTION FOR EMNRD FORES	SEEDLING PRODUCTION EMNRD FORESTRY		\$540,313.02	\$45,907.73	\$494,405.29	
		Total Restricted Funds		\$855,349.16	\$50,994.71	\$804,354.45	
Mora Research Center	APPLIED CHARGES	MORA RESEARCH CNTR-EQUIPMENT SVC	\$0.00	(\$2,000.00)	(\$1,463.54)	(\$536.46)	(\$27,160.47)
Mora Research Center	APPLIED CHARGES	MORA RESEARCH CNTR-VEHICLE SVC	\$0.00	(\$3,500.00)	(\$3,559.70)	\$59.70	(\$15,923.11)
Mora Research Center	OVERHEAD TRANSFERS	INDIRECT COST RECOVERY ASC-MORA	\$0.00	\$0.00	\$0.00	\$0.00	(\$10,759.81)
Mora Research Center	SALES & SERVICE	MORA RESEARCH CENTER SALES	\$25,947.23	\$17,494.11	\$51,008.76	(\$33,514.65)	(\$268,678.41)
		Total Sales and Service Funds	\$25,947.23	\$11,994.11	\$45,985.52	(\$33,991.41)	(\$322,521.80)
							* See note
Mora Research Center	STATE APPROPRIATIONS	IMPROVING NEW MEXICO'S FORESTS		\$0.00	\$0.01	(\$0.01)	
Mora Research Center	STATE APPROPRIATIONS	TARGET PLANT CONCEPT FOR FOREST		\$49,261.96	\$49,261.91	\$0.05	
Mora Research Center	STATE APPROPRIATIONS	JTH MORA RES CTR ADMIN		\$40,000.00	\$40,421.45	(\$421.45)	
Mora Research Center	STATE APPROPRIATIONS	TARGET PLANT CONCEPT FOR FOREST		\$1,798.00	\$1,796.54	\$1.46	
		Total State Appropriated Funds		\$91,059.96	\$91,479.91	(\$419.95)	

Note: " () " In the Fund Balance column indicates a positive number

AES RESEARCH

NMSU's Agricultural Experiment Station research publications provide information to help improve production techniques and efficiencies for farmers, ranchers, dairies, and other agricultural producers.



Forestry



Agronomy



Dairy



Weather and Climate



Horticulture



Task Force Reports



Livestock and Range



Water



Economics

DROUGHT-CONDITIONING DURING NURSERY PRODUCTION INFLUENCES PHYSIOLOGY AND RESOURCE ALLOCATION OF *POPULUS TREMULOIDES* AND *PINUS PONDEROSA* SEEDLINGS

Investigators: Dr. Owen Burney, Dr. Joshua Sloan, Dr. Jeremy Pinto

OBJECTIVE

This study was developed to test the effects of drought stress induced during the nursery growth phase on aspen and ponderosa pine seedling morphology and physiology.

NM PROBLEM ADDRESSED BY RESEARCH

Currently, reforestation efforts have very low survival rates (average 25%). Little is known in NM on how nursery cultural practices improve seedling survival in the field.

RESEARCH IMPACTS (ACTUAL OR POTENTIAL)

- Drought-conditioned treatments improve plant hydraulics.
- This has translated to higher survival and growth rates in the field.
- Nurseries and land managers from around the US are showing interest.
- One manuscript has been published.
- One MS student graduated NMSu

FUNDING AMOUNT/ SOURCE/ DURATION

\$75,000/ McIntire Stennis USDA/ Renewed annually

COLLABORATING INSTITUTION & OTHER PARTNERS

New Mexico Highlands University; Northern Arizona University/ U.S. Forest Service; Imerys Mining

GENETIC VARIATION IN ARIDITY ADAPTATION AMONG *PINUS PONDEROSA* POPULATIONS

Investigators: Dr. Owen Burney, Dr. Tom Kold, Aalap Dixit

OBJECTIVE

The objective of this study is to examine the aridity adaptability of ponderosa pine populations from a range of temperature and precipitation.

NM PROBLEM ADDRESSED BY RESEARCH

Currently, reforestation efforts have very low survival rates (average 25%). Little is known in NM on how seed source selection influences outplanting performance.

RESEARCH IMPACTS (ACTUAL OR POTENTIAL)

- Seed sources from drier, warmer environments have greater survival.
- Potential to incorporate assisted migration as a tool for reforestation in New Mexico.
- One manuscript has been published.
- PhD student at NAU.

FUNDING AMOUNT/ SOURCE/ DURATION

\$30,000/ McIntire Stennis USDA; Northern Arizona University funds/ Renewed annually; unknown duration for external institutional funds

COLLABORATING INSTITUTION & OTHER PARTNERS

Northern Arizona University, Utah State University/ U.S. Forest Service

ASSISTED MIGRATION – DEFINING SEED TRANSFER GUIDELINES FOR *PINUS PONDEROSA* IN A CHANGING CLIMATE

Investigators: Dr. Owen Burney, Dr. Josh Sloan

OBJECTIVES

The objective of this experiment is to assess the effectiveness of moving southern seed sources of ponderosa pine to a northern latitude located in the Valles Caldera National Park. Additionally, the use of log shading microsite environments on seedling performance will be examined.

NM PROBLEM ADDRESSED BY RESEARCH

Currently, reforestation efforts have very low survival rates (average 25%). Little is known in NM about assisted migration and microsite selections for reforestation.

RESEARCH IMPACTS (ACTUAL OR POTENTIAL)

- Southern seed sources are outperforming local sources.
- Microsite selection can improve survival and growth.
- Assisted migration is a likely tool to use in restoration.

FUNDING AMOUNT/ SOURCE/ DURATION

\$52,125/ National Park Service; McIntire Stennis USDA/ Renewed annually; 2015 to 2019 for NPS

COLLABORATING INSTITUTION & OTHER PARTNERS

New Mexico Highlands University/ National Park Service

SOUTHWESTERN WHITE PINE BLISTER RUST RESISTANCE GENE CONSERVATION

Investigators: Dr. Owen Burney

OBJECTIVE

Develop a grafting and gene conservation orchard program for blister rust-resistant Southwestern white pine.

NM PROBLEM ADDRESSED BY RESEARCH

Over 25% of white pine in NM are likely infected with blister rust. Identifying resistance is critical to the survival of this species.

RESEARCH IMPACTS (ACTUAL OR POTENTIAL)

- Four separate grafting events have occurred with success.
- Current outplanted grafted seedlings are thriving and will become a future seed or orchard.
- Strong interest continues within NM and the SW region.
- COVID-19 did not allow for grafting collections to occur in 2020. This will happen in 2021 with new funding.

FUNDING AMOUNT/ SOURCE/ DURATION

\$30,000/ U.S. Forest Service/ 2014 to 2021

OTHER PARTNERS

U.S. Forest Service

CENTERS FOR RESEARCH EXCELLENCE IN SCIENCE AND TECHNOLOGY (CREST)- FOREST RESTORATION TRIANGLE

Investigators: Dr. Owen Burney, Dr. Joshua Sloan, Dr. Kent Reid

PROJECT OVERVIEW

Forest restoration related to the prevention of forest fires and reforestation after fires occur.

NM PROBLEM ADDRESSED BY RESEARCH

Forest health in NM is declining significantly due to increased disturbances like wild fire. Little is known in NM on how to properly reforest post-fire landscapes.

RESEARCH IMPACTS (ACTUAL OR POTENTIAL)

- Improvements in water quality/ quantity, wildlife habitat, carbon sequestration, recreation, and many other resources.
- Current MS student at NMSU.

FUNDING AMOUNT/ SOURCE/ DURATION

\$5,000,000/ National Science Foundation/ 2020 to 2025

COLLABORATING INSTITUTION & OTHER PARTNERS

New Mexico Highlands University; New Mexico Forest and Watershed Restoration Institute/ U.S. Forest Service; The Nature Conservancy; NM State Forestry; Philmont Scout Ranch

POPULUS TREMULOIDES (ASPEN) RESTORATION IN THE SOUTHWESTERN U.S.

Investigators: Dr. Owen Burney, Dr. Karen Mock, Dr. Simon Landhausser

PROJECT OVERVIEW

Understanding nursery cultural practices and outplanting techniques to improve aspen restoration.

NM PROBLEM ADDRESSED BY RESEARCH

Sudden aspen decline is a major threat to forests in the southwestern U.S. Reforestation can provide genetic diversity to aid in restoring these aspen forests.

RESEARCH IMPACTS (ACTUAL OR POTENTIAL)

- First research related to aspen nursery production and planting in the southwestern region.
- Two manuscripts have been published.
- One MS student graduated Utah State University.

FUNDING AMOUNT/ SOURCE/ DURATION

\$30,000/ McIntire Stennis USDA; Utah State University and University of Alberta funds/ Renewed annually; Unknown duration for external institutional funds

COLLABORATING INSTITUTION & OTHER PARTNERS

Utah State University, University of Alberta/ Cedar Mountain Association

INFLUENCE OF THINNING OPERATIONS ON SEDIMENT YIELD IN NORTHERN NEW MEXICO

Investigators: Dr. Owen Burney, Dr. Sam Fernald, Dr. Doug Cram

PROJECT OVERVIEW

Evaluating the effects of forest thinning practices on runoff and sediment yield.

NM PROBLEM ADDRESSED BY RESEARCH

Concerns that forest thinning practices can have negative impacts on hydrological processes and thus, water quality.

RESEARCH IMPACTS (ACTUAL OR POTENTIAL)

- Identified potential negative effects associated with pile treatments on moderate slopes.
- Results from this paper will assist forest managers on proper thinning prescriptions.

FUNDING AMOUNT/ SOURCE/ DURATION

\$50,000/ Water Resources Research Institute NMSU; Range Improvement Task Force NMSU; JTH Forestry Research Center NMSU/ 2014 to 2020

COLLABORATING INSTITUTION & OTHER PARTNERS

New Mexico Water Resources Research Institute (WRRRI)/ Ministry of National Education and the General Directorate of Forestry - Turkey

CLIMATE-SMART REFORESTATION AFTER SEVERE FIRE IN NEW MEXICO

Investigators: Dr. Owen Burney

PROJECT OVERVIEW

Facilitate climate adaptation through assisted range expansion of conifer tree species in the Jemez Mountains, NM.

NM PROBLEM ADDRESSED BY RESEARCH

Large, catastrophic fires in New Mexico are increasing. Resources for reforestation are limited and natural regeneration could take centuries.

RESEARCH IMPACTS (ACTUAL OR POTENTIAL)

Provide a model for climate adapted reforestation for the southwestern U.S.

FUNDING AMOUNT/ SOURCE/ DURATION

\$126,000/ Climate Adaptation Fund- Wildlife Conservation Society/ 2019 to 2021

OTHER PARTNERS

The Nature Conservancy

PINUS PONDEROSA PROVENANCE TEST

Investigators: Dr. Owen Burney

PROJECT OVERVIEW

Defining seed transfer guidelines for *Pinus ponderosa* in the southwestern U.S.

NM PROBLEM ADDRESSED BY RESEARCH

No empirical data exists on seed transfer guidelines which could lead to planting failures in the SW.

RESEARCH IMPACTS (ACTUAL OR POTENTIAL)

This study will be used to create the first known empirical based seed transfer guidelines for NM, AZ, southern UT, and southern CO.

FUNDING AMOUNT/ SOURCE/ DURATION

\$200,000/ U.S. Forest Service; McIntire Stennis/ 2012 to 2100+ (long-term study)

OTHER PARTNERS

U.S. Forest Service

EVALUATING VEGETATION CONTROL AND ANIMAL PROTECTION MEASURES IN A POST-FIRE RESTORATION ENVIRONMENT

OBJECTIVE

Compare the interaction of animal protection methods and vegetation management intensity to understand the effectiveness of each treatment and the related cost-effectiveness.

IMPACTS AND RESULTS

- A new MS graduate student started at NMSU to assist with this research.
- Field sites have been identified.

OPTIMIZING OUTPLANTING STRATEGIES IN A POST-FIRE ENVIRONMENT THROUGH SEEDLING SIZE, PLANTING WINDOWS, AND NURSERY CONDITIONING

OBJECTIVE

Examine the impacts of planting windows, container size, and drought-conditioned seedlings on seedling performance in the field.

IMPACTS AND RESULTS

- A new MS graduate student started at NMSU to assist with this research.
- Field sites have been identified.

USING NUCLEATION STRATEGIES IN POST-FIRE ENVIRONMENTS

OBJECTIVE

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 seedlings. The long-term objective (10 – 30 years) is to determine which treatment combination will result in a rapid expansion from each nucleus.

IMPACTS AND RESULTS

- A new MS graduate student started at NMSU to assist with this research.
- Field sites have been identified.

Activities

Due to COVID-19, there were few outreach and community activities.



Below is a list of media contributions during 2020.

- Reforestation is a powerful weapon against climate change. Albuquerque Journal. (November 29, 2020)
- Growing pains: the race to plant billions of trees. American Forests. (September 1, 2020)
- Reforesting project planting new pines in burn scars of Las Conchas fire. KRQE. (August 31, 2020)
- Preparing trees for a changing world. Earth Island Journal. (August 24, 2020)
- After the fire, seeding New Mexico's future. The Nature Conservancy. (July 19, 2020)
- Replanting charred land. Santa Fe Reporter. (June 30, 2020)
- Group plans for fall forest planting of 'tree islands'. Albuquerque Journal. (June 23, 2020)
- New Mexico universities share \$5M for the forest research center. AP News. (January 13, 2020)





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