



# Southwestern USA Conifer Seed Collection, Processing, and Storage Workshop Summary

## Workshop Summary

Millions of acres within the Southwestern United States are in need of reforestation. Seed collection, processing, and storage are the first set of critical steps in the reforestation process. Seed collection is critical because our seed inventory is low across all land management agencies at a time when we have had increased high severity fires across the Western US; additionally, new federal policies are funding and supporting reforestation, but we need more seed to achieve the goals outlined in policies such as the REPLANT Act. Staff from the Colorado Forest Restoration Institute at Colorado State University, American Forests, The Nature Conservancy Colorado Chapter, New Mexico Highlands University, New Mexico State University, and New Mexico Energy, Mineral and Natural Resources Department gathered professionals from more than 70 organizations across nine states on February 23, 2023 to discuss challenges and opportunities relating to native conifer seed collection, processing, and storage. The goals of this workshop were to:

- **Connect land managers and other interested and affected parties** to discuss questions and concerns around seed collection, processing, and storage in Southwestern states;
- **Identify existing resources, information, datasets, funding, and policies** that may support native conifer seed collection, processing, and storage;
- **Assess the needs of current and future cone collectors in the Southwest** to determine knowledge gaps, appropriate resources, future policy, and a tentative regional strategy.

## Themes

Attendees discussed the challenges and opportunities of six thematic areas within Southwest seed and cone operations:

- Science and adaptation
- Logistics
- Business and economics

- Collaborative/cooperative needs
- Skills/vocational training
- Resource/policy

Pie chart displaying workshop attendees by institutional or Tribal affiliation. Examples of organizations/agencies/ Tribes in attendance: Federal and local/state managers - several National Forests and state forestry agencies; Bureau of Indian Affairs; non-profit organizations - Forest Stewards Guild, Trees Water People, numerous watershed coalitions; Tribes - Pueblo of Jemez; private industry - Dean Swift Seed Company, OneCanopy Nursery, and Silvaseed Company; research - Institute for Applied Ecology, Rocky Mountain Research Stations, Southwest Ecological Restoration Institutes, and numerous universities.

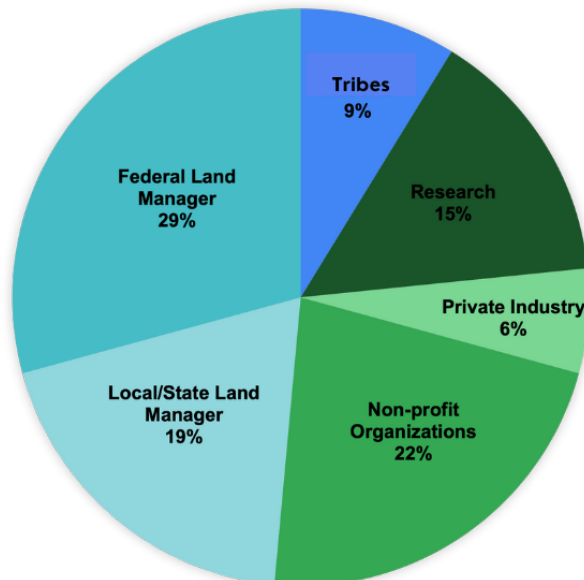


Photo credit: Lauren Wachs, The Nature Conservancy

## Current Challenges

This table outlines the current challenges within the six thematic areas discussed during the workshop. Current challenges are organized into the following categories: Capacity, Knowledge infrastructure, Equipment and facilities, Funding, Timing, Workforce capacity/retainment, Knowledge gaps, Accessibility, and Other. Within each box, the specific challenge within the thematic area is defined.

<p><b>Science/ adaptation</b></p>	<ul style="list-style-type: none"> <li>• <b>Equipment and facilities</b> - Aging equipment makes adapting to new or novel conditions or addressing knowledge gaps difficult.</li> <li>• <b>Funding/policy</b> - Limited funding for cone/seed operations research.</li> <li>• <b>Knowledge gaps</b> - Limited research on seed collection, cleaning, and storage, particularly in an era of changing temperature and drought.</li> </ul>
<p><b>Logistics</b></p>	<ul style="list-style-type: none"> <li>• <b>Accessibility</b> - Limited federal and private land access to meet immediate seed collection needs.</li> <li>• <b>Capacity</b> - Lack of internal capacity across all agencies and organizations.</li> <li>• <b>Equipment and facilities</b> - Cleaning, processing, and storing facilities have not been maintained overtime.</li> <li>• <b>Knowledge gaps</b> - Limited practical and applied knowledge of staff at all agencies and organizations relating to seed collection, cleaning, processing, or storage across the Southwestern states.</li> <li>• <b>Timing</b> - Limited knowledge on how to logistically ramp up cone collection efforts during short cone ripeness periods.</li> <li>• <b>Workforce capacity/retainment</b> - Lack of retainment methods for short and long-term capacity needs.</li> </ul>
<p><b>Vocational skills/ training</b></p>	<ul style="list-style-type: none"> <li>• <b>Knowledge infrastructure</b> - Few technical resources and methods to institutionalize new resources for training.</li> <li>• <b>Workforce capacity/retainment</b> - Lack of retainment methods for staff and trainings.</li> <li>• <b>Accessibility</b> - Existing trainings are not readily accessible and may have varying information depending on the state/region/agency/audience.</li> </ul>
<p><b>Business/economics</b></p>	<ul style="list-style-type: none"> <li>• <b>Capacity</b> - Current wage structures and benefits do not incentivize seasonal workers to apply for seed collection positions.</li> <li>• <b>Equipment and facilities</b>- Expensive upfront investment for seed processing equipment creates barriers for smaller businesses and local entities to enter seed operations.</li> <li>• <b>Timing</b> - The mismatch of seed production cycles and budget cycles cause unpredictability in seed availability.</li> <li>• <b>Workforce capacity/retainment</b> - Current wage structures and benefits do not incentivize workforce retainment.</li> <li>• <b>Other</b> - Tension between private and public seed operations and ownership make it challenging for both entities to collect seed.</li> </ul>
<p><b>Collaboration</b></p>	<ul style="list-style-type: none"> <li>• <b>Capacity</b> - Most staff capacity is already maximized, and thus dedicating capacity toward collaboration and seed related activities is difficult.</li> <li>• <b>Knowledge infrastructure</b> - Currently, there is a lack of structure, coordination, and process for effective, cross-jurisdictional collaboration between public and private entities.</li> <li>• <b>Funding</b> - There is limited funding and training directed toward collaboration.</li> <li>• <b>Timing</b> - Temporal differences for cone collection in each region challenge how and when to collaborate.</li> <li>• <b>Other</b> - Inconsistent and limited operational and permitting requirements across partners, agencies, and organizations challenge cross-jurisdictional collaboration.</li> </ul>
<p><b>Resources/policy</b></p>	<ul style="list-style-type: none"> <li>• <b>Funding</b> - Infrastructure, funding, and policy includes many logistical challenges and administrative barriers.</li> <li>• <b>Accessibility</b> - US Forest Service (USFS) seed procurement plans must be in place before operational cone collections can be done, which was viewed as an administrative barrier by some workshop attendees. USFS limits or denies cone collection permits to non-federal entities which challenges goal of seed collection activities across four states; additionally, it is difficult to assign seed collection as high priority over other forest management priorities within land management agencies.</li> <li>• <b>Other</b> - Federal partners have trouble accessing private land while private partners have trouble accessing federal land.</li> </ul>

## Current needs and proposed actions

### Vocational skills and trainings

Discussions of challenges and barriers during the workshop revealed current and future needs to enhance workforce trainings; key insights include:

- Increased direct funding for seed/cone operations is needed to increase skills, capacity, and to retain a dedicated workforce for future reforestation needs;
- Identify ways to create long-term career options within seed/cone operations balanced by levels of education is necessary for workforce retainment;
- Direct technical documentation and in-person training sessions are needed for all parts of practical seed/cone operations, including the following:
  - how to identify and collect viable seed based on individual tree species;
  - best practices for cleaning, processing, and storing seed;
  - adapting seed for climate change;
  - best practices for nursery and seedling production;
  - prepping sites for seedling plantings.
- Standardize the above suggested resources across local, state, and regional boundaries to make them more accessible and effective.



Photo credit: © Liz McNair

### Science and adaptation

Workshop attendees identified the need to increase research at a landscape scale and expand communication across boundaries. This would increase overall knowledge for successful seed operations, increase the amount of seed available, and increase knowledge around climate-informed seeding operations. Some specific research ideas include:

**Climate-based seed transfer science and guidelines:** Increase long-term monitoring and research around sourcing and planting seed in different ecotypes to adapt to climate change. Specific areas of research include:

- Common garden experiments;
- Research on assisted gene flow and migration;
- Differences in seed/seedling survival based on seed provenance;
- Exploring ecotypes for seed source selection;
- Genetics vs. landscape scale procurement vs. large-scale feasibility of seed procurement;
- Create guidelines based on best-available science for seed transfer in a changing climate.

**Provenance trials:** Research focused on creating new seed zones and expanding current seed zones for all species.

**Predictive models and tools:** Models and decision support tools that may assist in choosing seed sources while considering climate change were identified as critical. Specific areas of research include:

- Models that predict cone crop production through remote monitoring systems that measure cone development and ripeness;
- Expand on current regeneration mapping program;
- Models predicting future production years.

**Seed operations research:** Research toward improving seed collection, cleaning, processing, and storage. Specific areas of research include:

- Seed cleaning requirements for individual species to ensure successful storage;
- Seed viability testing at the time of collection;
- Improved seed transfer guidelines that account for climate adaptation;
- Enhanced seed germination testing.



Photo credit: The Nature Conservancy

## Current needs and proposed actions, cont.

### Business and economics

Some of the greatest challenges and barriers in seed operation business and economics include the mismatch of seed production and budget cycles, equipment for seed operations, current wage structures and benefits which disincentivize workforce entry, and tension between private and public seed operators. To address these challenges, future actions include:

- **Targeted funding** - Provide funding to support public and private collaboration, incentivize nurseries to increase seedling production, and provide loans for seed processing equipment to small businesses and local entities;
- **Long-term agreements** - Establish long-term agreements across agency and regional boundaries to standardize collection permits, increase seed operation longevity, and increase predictability for seed operations;
- **Business models** - Create new business models that will last when public funding expires and include consistent labor schedules, dependable wages, and better benefits;
- **Flexible labor force** - Seasonal seed collection work schedules pair well with the seasonality of nursery operations; therefore, tying nursery and seed collection operations could help sustain the seed collection workforce;
- **Boost demand signals** - Amplify economic demand signals for seed to increase seed collection. One potential suggestion includes nurseries publicly releasing an annual list of collection needs including species, seed zones, quantities, and prices.



Photo credit: Lauren Wachs, The Nature Conservancy

### Logistics of Seed Operations

Several challenges in the logistics of seed operations make this work difficult.

- **Cones mature during a short time window**, and there is limited knowledge on how to ramp up cone collection efforts during this short time;
- **Accessing private and federal lands** to meet immediate seed collection need is difficult;
- **There is a small number of contractors receiving all seed collection needs from the West at once**, resulting in reduced collection or underripe cones;
- **Collected seeds are often sent long distances for cleaning and storage**, reducing accessibility and timely responses in areas that need them;
- **Cleaning, processing, and storing facilities have not been maintained over time**;
- **Few/no internal capacity or retainment incentives exist in seed/cone operations.**

Some proposed actions to address these challenges and barriers include:

- **Raising public awareness for seed operation needs** could increase volunteer and agency capacity;
- **Establishing local holding facilities, in-forest storage facilities, or contracting local, private companies to clean, package, and store seeds will help agencies and organizations** sending seeds far distances, increasing risk of damage to seeds;
- **Information about locations of current key seed production areas and how to identify new areas** should be shared amongst partners;
- **Seed orchards can produce seed for future years** but take a long time to produce cones; therefore, they must be established soon to address future reforestation needs;
- **There are incongruent permitting structures across agencies and states.** Federal and non-federal partners must create a standardized, commercial-scale permitting system;
- **Creating a viable industry for seed collection** that employs internal agency staff, volunteers, and other entities is crucial for addressing future reforestation needs;
- **Creating a large-scale database for scouting and survey data**, plus mapping of seed sources for each season.

## Current needs and proposed actions, cont.

### Collaboration

Collaboration is necessary to address the challenges in seed collection, processing, and storage; however, collaboration comes with a unique set of barriers. Currently, there is a lack of structure, coordination, and process for effective, cross-jurisdictional collaboration between public and private entities across the Southwestern USA. Inconsistent operational and permitting requirements challenge cross-jurisdictional collaboration. Most agency staff capacity is already overburdened and therefore dedicating capacity toward collaboration is difficult. Temporal differences for cone collection in each region challenge how and when to collaborate. There is limited funding and training directed towards collaboration.



Photo credit: Joe Mintzer

- **Share seed** – Increased willingness to share seed across partners will promote collaborative efforts;
- **Communication** – Partners need an overall increase in communication about existing collaborations as well as connecting entities that are not currently communicating;
- **Funding** – An increase in funding aimed directly toward collaboration is needed;
- **Consistent campaigns** – All entities need to agree upon a consistent public message for seed collection needs to increase overall public awareness;
- **Seed cooperatives** – Overall collaboration can be raised by creating spaces to report seed/cone needs, share production areas, exchange knowledge, and report where seed is available;
- **Sustain and support staff** – Finding ways to increase capacity and support staff is necessary to increase collaboration;
- **Coordination** – Increased coordination in seed collection efforts is needed, especially across organizations within shared seed zones.

### Resources/Policy

Resources and policy impact each of these thematic areas. Policymakers should consider the following actions:

- **Administrative** – Creating reasonable expectations/timelines for reforestation, creating streamlined processes for USFS procurement plans for operational cone collection, and creating regional Indefinite Delivery Indefinite Quantity (IDIQ) or Blanket Purchase Agreements (BPA) for contract collection efforts will greatly aid agency systems for seed collection and reforestation;



Photo credit: The Nature Conservancy

- **Seed Transfer Coordination** - Creating greater coordination of seed transfer and only allowing a specific number of contracts within given seed provenances would increase cooperation for large-scale seed collection;
- **Access** – Creating access systems for private land and federal land via permitting process for seed collection will dramatically increase the opportunity, spatial scale, and genetic diversity of seed collections;
- **Volunteers**- Advocating for and funding volunteer programs will encourage community involvement in cone collection and reforestation efforts which will further increase cone collection, seed stocks, and genetic diversity of stocked seed.

## Current Resources

Resources	Description
<b>Tools</b>	<ul style="list-style-type: none"> <li>• <b>Climate Smart Seed Lot Selection Tool:</b> A web-based mapping application designed to help natural resource managers match seedlots with planting sites based on climate information. This tool is not species specific. <a href="https://www.fs.usda.gov/ccrc/tool/seedlot-selection-tool">https://www.fs.usda.gov/ccrc/tool/seedlot-selection-tool</a></li> <li>• <b>Climate Distance Mapper:</b> GIS mapping tool designed to help match seed sources with restoration sites. <a href="https://usgs-werc-shinytools.shinyapps.io/Climate_Distance_Mapper/">https://usgs-werc-shinytools.shinyapps.io/Climate_Distance_Mapper/</a></li> <li>• <b>Southern Rockies Reforestation Tool:</b> This tool can be used to prioritize post-fire planting in ponderosa pine and mixed-conifer forests in the Southern Rockies based on maps of fire severity as well as current and future climatic suitability. <a href="https://kylerodman-eri.users.earthengine.app/view/srrt">https://kylerodman-eri.users.earthengine.app/view/srrt</a></li> <li>• <b>Species Potential Habitat Tool:</b> This tool is designed to identify species or vegetation types that are suitable for specific sites using climate change scenarios. Using this information, forest managers can promote the transition of forests to species compositions that are better adapted to future climates. <a href="https://specieshabitattool.org/spht/">https://specieshabitattool.org/spht/</a></li> <li>• <b>Burn Severity Portal:</b> An interagency portal to comprehensive federal burn severity data for use in post-fire reforestation planning. <a href="https://burnseverity.cr.usgs.gov/">https://burnseverity.cr.usgs.gov/</a></li> </ul>
<b>Research</b>	<ul style="list-style-type: none"> <li>• <b>Reforestation, Nurseries, and Genetic Resources (RNGR.net):</b> This website contains a wealth of information for producing and planting trees for reforestation and conservation purposes. <a href="https://rngr.net/">https://rngr.net/</a></li> </ul>
<b>Seed collection, cleaning, and processing resources</b>	<ul style="list-style-type: none"> <li>• <b>Reforestation, Nurseries, and Genetic Resources (RNGR.net) Directory and Marketplace:</b> This new directory is an online source for finding businesses that support reforestation related activities across the US, and you can search the directory by name, state, product, or business type. <a href="https://rngr.net/marketplace/directory">https://rngr.net/marketplace/directory</a></li> </ul>
<b>Related articles and guides</b>	<ul style="list-style-type: none"> <li>• <b>Woody Seed Plant Manual</b> - <a href="https://rngr.net/publications/wpsm">https://rngr.net/publications/wpsm</a></li> <li>• Maxwell, H. A., &amp; Aldhous, J. R. (1967). <b>Seed collection in North-west America.</b> The Commonwealth Forestry Review, 51-62.</li> <li>• <b>Reforestation Practices for Conifers in California.</b> While developed for California, Chapter 5 of this guide outlines seed selection, collection, processing and storage and is a great resource. <a href="https://ucanr.edu/sites/forestry/files/337245.pdf">https://ucanr.edu/sites/forestry/files/337245.pdf</a></li> <li>• <b>USDA National Tree Climbing Guide</b> (2015) <a href="https://www.fs.usda.gov/treeclimbing/media/NationalTreeClimbingGuide2015April.pdf">https://www.fs.usda.gov/treeclimbing/media/NationalTreeClimbingGuide2015April.pdf</a></li> </ul>

## Conclusion

This workshop sought to assess federal, state, sovereign nations and private sector needs and capacity for supplying native conifer seeds for ecological restoration in the Southwest US. Workshop attendees reported that native conifer seed supply is severely insufficient and as a result, millions of acres of Southwestern forests are at risk of losing biodiversity and carbon associated with native forest communities. There is an urgent need to build a native seed supply in the Southwest, which we believe is achievable. Increased support for research, logistics, training, collaboration, and policy are the right tools to address this challenge.



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March 2024 • CFRI-2403 • [cfri.colostate.edu](http://cfri.colostate.edu)

This work was supported by the Colorado Forest Restoration Institute through the  
Southwest Forest Health and Wildfire Prevent Act.



Citation: Wilson, M.A., Chambers, M.E., Schloegel, C.A., Pansing, E.R., Foe, R., Burney, O.T., Sloan,  
S.L., Rempel, A., (2024) Southwestern USA Conifer Seed Collection, Processing, and Storage  
Workshop Summary. Colorado Forest Restoration Institute. CFRI-2403