Oregon State Reforestation Needs, Capacity, and Pipeline Assessment

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Executive Summary

Oregon faces an escalating and complex challenge in reforesting its forests, driven by intensifying wildfires, ongoing timber harvest activities, and the imperative for climate adaptation. In response to this critical need, the Oregon Department of Forestry (ODF) and American Forests collaborated to develop a comprehensive assessment of reforestation needs and the reforestation supply chain. This work was initiated and funded by a grant from the Oregon Watershed Enhancement Board (OWEB), with additional support from the ODF, in recognition of the urgent need to understand and address reforestation challenges in Oregon. The OWEB grant specifically aimed to assess the current and forecasted need for reforestation and the capacity of the reforestation pipeline to deliver climate-adapted reforestation across public, private, and tribal lands in Oregon.

The resulting "Oregon Reforestation Needs, Capacity, and Pipeline Assessment" provides crucial insights by analyzing current and future projected reforestation needs, identifying barriers and opportunities to scale reforestation projects, and exploring the capacity of the nursery and service provider sectors. Ultimately, it offers strategic opportunities and recommendations to increase and improve reforestation efforts across the state.

Current and Projected Reforestation Need Assessment

Oregon faces a significant reforestation need from both timber harvest and high-severity wildfires. Between 2015 and 2023, a total of 499,608 acres of forest land in Oregon were harvested using practices necessitating replanting, with 77.7% of this occurring in Western Oregon. Concurrently, a median of 609,795 acres of cumulative current reforestation need from wildfire was identified between 2014 and 2023. Notably, 83% of Western Oregon's wildfire-driven reforestation need from this period is attributed to the 2020 Labor Day Fires.

Future forecasts of Oregon's reforestation needs are projected to increase dramatically due to increased wildfire activity. Western Oregon's cumulative projected reforestation need is expected to increase by 539% by the 2060-2069 period, reaching approximately 1,206,580 acres from the current 188,890 acres. Eastern Oregon is projected to see a 442% increase, rising from 227,490 acres to 1,233,520 acres in the same timeframe. Southwestern Oregon anticipates a comparable 532% increase as Western Oregon, from 186,820 acres to 1,180,740 acres. These projections underscore the necessity for proactive planning across the entire reforestation supply chain, including strategies for seed collection, nursery capacity, planting operations, and post-planting monitoring.

Nursery Capacity, Limitations, and Recommendations

Nurseries serving the Pacific Northwest region report a total annual seedling capacity ranging from 162.75 million to 284.75 million seedlings. Many operate at or near maximum capacity, particularly for container stock, while bareroot seedlings are increasingly underutilized,

suggesting a market shift. While 62% of surveyed nurseries indicate a latent capacity for expansion, this is largely constrained by uncertainty of future demand, infrastructure limitations, labor availability, and inconsistent ordering patterns, often driven by short-term agreements. Conifer seed inventories are modest, with most nurseries having a two-year supply or less, and fire restoration planting supplies have significantly depleted over the last decade due to large scale wildfires.

Key recommendations to support the nursery industry in meeting current and projected reforestation demands include developing strategic planning with long-term contracts, fostering greater collaboration and knowledge sharing across the reforestation supply chain, conducting continued research to understand the disconnect between need and demand, and establishing a formal reforestation network to optimize seed supply, develop the workforce, and build critical partnerships.

Reforestation Service Provider Capacity, Limitations, and Recommendations:

Reforestation service providers in the Pacific Northwest report steady or increasing demand, particularly due to wildfires, yet face significant operational constraints. Key challenges identified include unfair pricing and competitive bidding practices leading to unsustainable profit margins, workforce instability due to difficulties in retaining seasonal employees due primarily to complex reliance on the H-2B temporary worker program, burdensome regulatory and federal bureaucratic hurdles, and critical funding gaps, especially for small woodland owners, compounded by restrictive grant eligibility. Despite these obstacles, and if these issues are addressed, providers generally express interest and possess the capacity to undertake more reforestation projects.

Recommendations include implementing long-term contracts, promoting fair pricing models, increasing and strategically allocating accessible funding, strengthening workforce development, providing targeted support for small woodland owners, developing a comprehensive regional reforestation strategy, and establishing a centralized digital information hub. Addressing these challenges will foster a more stable, equitable, and effective reforestation sector that is better suited to support the region's ecological health, economic resilience, and long-term sustainability.

In conclusion, addressing Oregon's growing reforestation needs requires a comprehensive and coordinated approach. This involves strategic planning informed by current and projected needs, fostering collaboration across the entire supply chain from seed to planting, and addressing critical workforce and financial barriers. This assessment lays a strong foundation for developing evidence-based strategies and policies to enhance reforestation efforts across the state.

Contents

This report is organized into three distinct chapters to facilitate ease of sharing and allow readers to focus on pertinent components. Each section is designed to stand alone, featuring its own literature cited, table of contents, figures, tables, page numbers, and abstract. Supplemental appendices and data have been provided to ODF.

Acknowledgements

We extend our gratitude to OWEB for bringing together this partnership between Oregon Department of Forestry (ODF) and American Forest scientists and land managers.

We are also profoundly grateful for the invaluable contributions of all ODF staff. Special thanks are due to Don Kaczemarek, Lori Bell, John Walter, Danny Norlander, and Ryan Gordon. In addition, we would like to thank Jeff DeGraan, Isabella Akker, and Israel Golden. Their thoughtful reviews, insightful suggestions, and dedicated efforts significantly enriched this assessment. This collaborative work has laid a strong foundation for strategic opportunities and recommendations to enhance reforestation across Oregon State.

Introduction

The Pacific Northwest faces increasing reforestation needs driven by the intensifying effects of wildfires, drought, pests and diseases, and ongoing timber harvest activities. In Oregon, the 2020 Labor Day Fires and the 2021 fires in Klamath and Lake Counties particularly highlight the escalating extent and severity of wildfire disturbance. In addition to wildfire, reduced precipitation and increased prevalence of forest pathogens necessitate scaling reforestation with methods adapted to current and projected climate conditions.

Recognizing this critical challenge, the Oregon Department of Forestry (ODF) and American Forests collaborated on a comprehensive assessment to quantify the current and forecasted need for reforestation and to evaluate the capacity of the reforestation pipeline to deliver climate-informed reforestation strategies across public, private, and tribal lands in Oregon. This initiative was supported by a grant from the Oregon Watershed Enhancement Board (OWEB) and additional funding from ODF, underscoring a joint commitment to enhancing the resilience of Oregon's forests.

Current and Projected Reforestation Need for Oregon, USA

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Abstract

Background: Oregon faces a growing reforestation need driven by both stand-replacing wildfires and ongoing timber harvest, with climate change projected to intensify the frequency, size, and severity of future wildfires. To quantify the scale of this need and support proactive planning, the Oregon Department of Forestry (ODF) and American Forests conducted a spatial and temporal assessment of reforestation need across all forested lands in Oregon from 2014 through 2069. This analysis combined historical disturbance data with downscaled CMIP6 climate projections to estimate current and projected reforestation need.

Results: From 2015 to 2023, reforestation need from timber harvest was concentrated west of the Cascade Divide, particularly in Western Oregon, while wildfire was the dominant driver of need in Eastern Oregon from 2014 to 2023, although Southwestern Oregon exhibited high need from both harvest and wildfire. In Western Oregon, the 2020 Labor Day Fires accounted for 83% of wildfire-related reforestation need. Looking forward, by 2069, projected wildfire-driven reforestation need is expected to rise by 539% in Western Oregon, 442% in Eastern Oregon, and 532% in Southwestern Oregon. Projected seed need was also estimated by forest type to inform future seed supply and nursery capacity planning, with ponderosa pine in Eastern Oregon having the most demand followed by Douglas-fir in other regions.

Conclusion: Oregon's reforestation demand is expected to rise sharply with increased fire severity throughout the state, especially under hotter and drier conditions in Eastern Oregon. Meeting this need will require climate-informed planning and investment across the reforestation pipeline, including seed collection, nursery infrastructure, planting operations, and long-term monitoring. This assessment provides a quantification and foundation for scaling up reforestation efforts to enhance forest resilience and carbon sequestration.

Keywords: reforestation, wildfire, timber harvest, seed need, climate change, Oregon, forest regeneration, seedling demand

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We would like to express our gratitude for helpful insights and reviews from John Walter, Ryan Gordon, Don Kaczmarek, Lori Bell, Danny Norlander, and all other Oregon Department of Forestry staff that contributed to the project. In addition, we would like to thank Jeff DeGraan, Isabella Akker, and Israel Golden for their contributions and insights.

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Introduction

Active reforestation via seedling planting is a key management action that supports sustainable timber harvest practices, recovery from wildfire and other natural disturbances, increased forest cover under a changing climate, carbon sequestration, biodiversity, and provision of clean water (North et al., 2019). Historically, national reforestation efforts via seedling planting focused on ensuring a sustainable timber supply and recovery from wildfires. However, timber harvests declined in the 1970s through the 1990s, and wildfire extent, frequency, and area burned at high severity has increased considerably (Parks and Abatzoglou, 2020; Dumroese et al., 2005). This has resulted in wildfire emerging as a major driver of reforestation need in the Western United States (e.g., 81% on National Forest System lands in 2022; accessed March 2025).

Despite national declines over the past decades, timber harvest in Oregon remains a key economic driver for the state, providing over 71,000 jobs and $1.1 billion in wages in 2016 (Oregon Forest Resources Institute 2019). Timber harvest generates reforestation need as under Oregon Forest Practices Act (FPA) Rules, landowners must complete replanting of harvested ground within two years of a harvest, ensuring that within six years of harvest, the young trees are "free-to-grow", meaning they are vigorous (> 4.5 feet tall and out of the browsing level), well-distributed, and ready to grow successfully into a young forest) (Rose et al., 2006). As such, much of the reforestation need across Oregon, and particularly in Western Oregon, is driven by the legal requirement to replant after timber harvest. Estimating the acreage of timber harvest in recent years provides a baseline for reforestation planning. If this demand for timber remains stable in the future, the baseline estimate can provide guidance for future reforestation needs generated by timber harvest.

In addition to timber harvest, an accelerated increase in post-fire reforestation need caused by wildfire across the Pacific Northwest (PNW) is attributed to more frequent wildfires that burn a greater proportion of lands at high severity relative to recent and modeled historical fire regimes (Parks and Abatzoglou, 2020; Haugo et al., 2019; Halofsky et al., 2018). Collectively, these changes impact forest recovery mechanisms and can lead to delayed regeneration or regeneration failure. Increased wildfire frequency can result in a fire return interval outside the range of natural variability, while an increased proportion of area burned at high severity can lead to reduced seed availability and a decrease in beneficial bioclimatic buffers that facilitate the natural regeneration of trees (Wolf et al., 2021; Enright et al., 2015). Climate change—mainly through an increase in water stress via more frequent and severe droughts and changes to timing in precipitation and snow melt—can directly impact forest recovery by applying more stressful hydroclimatic conditions on seedling regeneration, resulting in an increase in tree mortality, particularly in hotter and drier sites (Wilson et al., 2021; Tepley et al., 2017).

Collectively, these climatic changes increase the risk of community shifts and forest type conversion to non-forested ecosystems (e.g., Coop et al., 2020). These impacts are projected to

increase as the effects of climate change become more severe and fire regimes continue to change (Davis et al., 2023; Coop et al., 2020; Halofsky et al., 2018).

As such, estimating current and projected reforestation need requires both an estimate of current needs and drivers as well as an understanding of how future climate change may impact wildfire regimes and hence future reforestation needs. Regardless of harvest or wildfire, the disturbances and drivers that result in reforestation need, successful reforestation planning requires a confident estimation of current and projected future reforestation need to facilitate seed collection planning, coordinate nursery infrastructure, and secure the necessary workforce capacity and funding prior to planting seasons. Quantifying these needs requires both an estimate of current reforestation needs and drivers as well as an understanding of how future climate change may impact wildfire regimes and hence future reforestation needs. To provide an estimate of Oregon's reforestation needs and facilitate advance planning, we assessed the (1) current (2015-2023) reforestation need generated by timber harvest, as well as the (2) current (2014-2023) and (3) projected (2024-2069) acreage of reforestation need generated by wildfire. The current reforestation need from timber does not include 2014 because it was the first year of data collection for that dataset. We also (4) estimated potential and projected seed need by region and forest type to facilitate seed collection and storage over time.

In this study, "current reforestation need" is the potential area that could require reforestation due to stand-replacing wildfire (2014-2023) or timber harvest (2015-2023), based on an assessment of geospatial and remote sensing data. It is likely that some areas of potential current reforestation need have already been reforested, and as such ground-truthing or other forms of validation will be needed to verify the true operational reforestation need prior to planting. Likewise, "projected reforestation need" is modeled from total acreage of potential current reforestation need from wildfire scaled in relation to future wildfire probability. To estimate future wildfire probability, we use data from state-of-the-art general circulation models (GCMs) and a fire risk model developed by Anderegg et al. (2022). As with current reforestation need, projected reforestation need is an estimate of future needs based on historic trends and available climate projections useful for planning efforts and will require verification as future disturbances occur.

Methods

Seed Zone, Region, Forest Type, and Ownership

To evaluate current and projected reforestation need at multiple scales, we assessed seed transfer zones, regions, forest type, and ownership. Seed transfer zones (c.1996; accessed December 2024) were acquired from ODF. We aggregated these into three general regions (Fig. 1): Western Oregon, Southwestern Oregon, and Eastern Oregon, based on position relative to the Cascade Divide (West vs. East) and fire regime (West vs. Southwest).

To assess forest types in the reforestation need analysis, we used the National Forest Type (NFT; accessed October 2024) data from the United States Forest Service Geospatial Technology and Applications Center (GTAC).

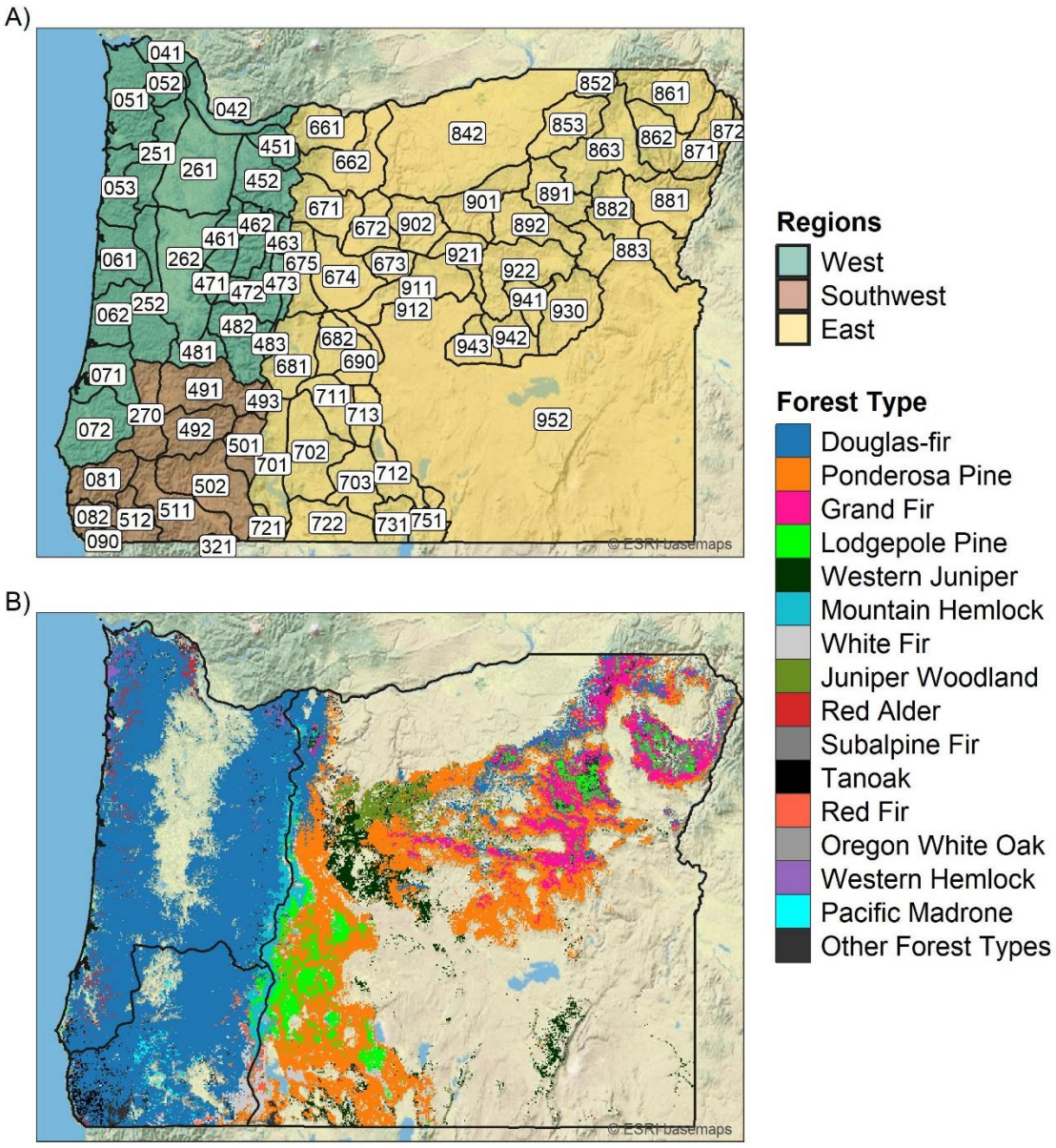

Figure 1. (A) Seed transfer zones and regional divisions (Western, Southwestern, and Eastern Oregon). (B) Forest types listed in descending order of total acreage. Forest types with less than 130,000 acres were grouped into “Other Forest Types”.

Ownership Land Management (accessed November 2024), acquired from ODF, was used as the base ownership data. We supplemented this layer with Private Industrial Ownership (accessed November 2024), to better capture private industrial landowners. In the combined layer, there were three possible private designations: “Private Industrial”, “Private Non-industrial”, and “Private.” “Private” lands are likely to be non-industrial forests and were thus reclassified. Other ownership classifications were simplified in the final ownership layer. “ODF”, “ODFODSL”, and “ODSL” were combined into “State ODF.” “ODFW”, “ODOT”, “ORPD”, “OR”, “OSU”, and “OUS” were combined into “State_Other”. “USFS” land was kept as “Federal USFS”, while “BLM”, “BPA”, “DOD”, “DOE”, “FAA”, “FWS”, “GSA”, “NPS”, “USACE”, “USBR”, and “USDA” were combined into “Federal Other”. “BIA”, “TRIBAL”, and “FEE” were combined into “Tribal” (FEE was determined to be tribal land after visual inspection). “LG” was kept as “Other”. We removed designations of “Water” and “WATER” from the final layer.

Current Reforestation Need

We estimated the current reforestation need from 2015 to 2023 from commercial timber harvest, and 2014 to 2023 from wildfire. These estimates were derived from different datasets and methodologies, which are described in the following sections. The assessment presented in this report does not account for reforestation that has occurred in areas identified as having a reforestation need. We made this decision for two reasons. First, the baseline (i.e., current) reforestation need was used to scale future projections, requiring a full assessment of the generated need, not just the remaining need. Second, comprehensive data on reforestation across all lands and ownerships is limited. Additional validation and verification will be required to determine the current reforestation need remaining after accounting for completed efforts.

Current Reforestation Need – Harvested Areas

We estimated timber harvest acres from 2015 to 2023 to establish the baseline reforestation need generated by harvest. Inclusion of a harvest event within this report does not imply that the landowner has not completed the statutory requirements to replant required under the Oregon Forest Practices Act Reforestation Rules (OAR 629-610-0000 through 629-610-0100). Rather, because of these requirements, we assume that all listed harvest will need to be replanted, thus influencing the baseline demand for seed and seedlings. The baseline begins in 2015 and differs from the wildfire baseline because the first year of the datasets (described below) was 2014 and incomplete.

The harvest reforestation needs estimate is based on two publicly available GIS layers which depict proposed harvest activities in Oregon. For state and private ownerships, we used the ODF Forest Activity Electronic Reporting and Notification System (FERNS) database accessed via the ODF GIS portal in October 2024. Data contained within this layer include activity boundaries for E-Notifications related to road construction and maintenance, harvesting, site preparation by treating slash, reforestation, or the use of pesticides or fertilizers. For data pertaining to harvest on USFS owned or managed lands we used the USFS Forest Activity Tracking System (FACTS) Timber Harvests layer downloaded from the FSGeodatabase Clearinghouse (accessed October

2024). The Timber Harvests layer contains information related to planned and accomplished treatments as part of the USFS Timber Harvest program of work. Defined commercial timber harvest polygons for other non-USFS owned federal lands (e.g., BLM, NPS) are not publicly available, and as such were excluded from this analysis.

Prior to use, the data required a QAQC and subsetting process. For the FERNS data, we first filtered data by starting date ≤ 2023 to ensure we would capture all harvests which could be completed during this period (FERNS was introduced in 2014, therefore no records from before this period were present in the dataset). We further subset the data to only include records pertaining to clearcut style harvest types 'Clearcut/Overstory Removal') based on the assumption that clearcut or canopy removal harvest activities may require interventions such as site prep or planting for the forest to regenerate post-harvest. As a result of this subsetting process, we removed over 80% of the 195,970 records, leaving us with 37,192 records. We next corrected for overlapping activity boundaries within the FERNS dataset to prevent double counting, and to correctly attribute a proposed harvest activity to the time range in which it was completed. For this process, we defaulted to the latest ending date for a record, removing an additional 2,142 records for which two or more E-Notifications covered an identical activity area.

For FACTS Timber Harvest data, we subset the data to include only completed activities which occurred in Oregon with an ending date between 2014 and 2023. We selected only those timber harvest practices that would not result in natural regeneration due to removal of seed sources and thus require replanting ('Stand Clearcut (EA/RH/FH)' and 'Stand Clearcut (w/ leave trees) (EA/RH/FH)'). We intentionally exclude harvest types which occur as the result of a disturbance (e.g., sanitation or salvage harvests) as well as those even age harvest types which are meant to release established regeneration from competition (e.g.,'Shelterwood Removal Cut (EA/NRH/FH)'). We also recognize that, depending on the exact silvicultural practice implemented, some low-density planting may be required to supplement regeneration following nominally uneven-aged or regeneration harvests. However, determining the exact seed need under these circumstances was beyond the scope of this analysis. Finally, we checked each FACTS record to ensure that it was not otherwise reported and replicated in the FERNS data.

To validate harvests, we compared the FACTS and FERNS activity boundaries to the forest loss dataset from Hansen et al. (2013). This dataset, which is updated annually, depicts forest gain and loss globally at 30-m resolution as calculated from a spectral index derived from multispectral Landsat imagery. For a harvest area to be considered "validated," it must match spatially and temporally to a record of forest loss. Although FACTS Timber Harvest data are internally validated, we chose to apply this same validation process to both datasets. Of the 1,304,362 acres of harvest from FACTS (21,160 acres) and the FERNS (1,284,201 acres) datasets between 2014 and 2023, we validated 503,511 acres.

Finally, we estimated the overlap between validated harvest footprints and wildfire footprints. This analysis indicated that there are 16,294 acres of overlap, meaning that about 3% of the total area of harvest was likely from salvage harvest rather than a true even-aged harvest type. These areas

of overlap are included in our total estimate of current reforestation need from harvest because regardless of causal agent, there is a legal requirement to reforest after any even-aged or salvage harvest occurs, and thus a consequent need for seed and seedlings.

Upon collating the validated harvest data by year, we determined that in 2014 the total harvest area was substantially lower than all other years (3,903 acres), or just 7.7% of the ten-year average. A possible explanation for this abnormally low harvest is that 2014 was the first year in which forest operations were required to be reported to the FERNS database (announced in September 2013), and as such reporting in this first year may have been limited. In addition, FERNS E-notifications are active for up to a year, after which the responsible party must resubmit the E-notification. In such cases, which result in overlap of proposed harvest polygons, we defaulted to taking the most recent year in which an E-notification was submitted. This means that the validated harvest area from FERNS for 2014 only represents E-Notification submitted and completed in 2014, while for all subsequent years the validated harvest area may represent harvest first proposed via E-Notification in a prior year and only harvested when market conditions were most favorable. Of the 35,050 FERNS E-Notifications representing a unique geographical area in our dataset between 2014 and 2023, only 988 (2.8%) were filed in 2014, further reinforcing that the lower-than-average harvest level in 2014 is likely a product of data constraints rather than an actual low point in harvested area.

After discussing these data limitations with ODF staff, we made the decision to drop all harvest data from 2014 from our analysis. To provide an estimate similar to the reforestation need from wildfire, we summed validated harvest areas for each seed zone over the period between 2015 and 2023, giving us a nine-year estimate. Then to estimate variability within the sample, we resampled the annual data (with replacement) 10,000 times, and from this distribution of resampled sums calculated the 25th and 75th percentiles.

Current Reforestation Need – Wildfire

We used stand-replacing severity wildfire and distance from potential seed source to estimate current reforestation need from wildfire. To map stand-replacing fire, we first acquired all fire perimeters from 2014 to 2023 from the National Interagency Fire Center (NIFC; accessed August 2024), filtering out any perimeters smaller than 25 acres. We used Google Earth Engine (GEE) to calculate the Relativized Burn Ratio (RBR) from mean composite pre-fire year and post-fire year Landsat imagery and apply a phenological offset, following the approach proposed by Parks et al. (2018). Stand-replacing fire was identified using an RBR threshold of 283 (Parks et al. 2018). We used Global Ecosystem Dynamics Investigation (GEDI)-derived vegetation height data (Potapov et al., 2021) to determine potential seed sources, by finding pixels that were unburned or had an RBR value less than 283, and a vegetation height of at least 5 m. We then computed the distance from each pixel identified as having stand-replacing fire to the nearest potential seed source. We used National Land Cover Database (NLCD; accessed September 2024) cover type data to mask out developed land, agriculture/pasture, snow/ice, and water. We also masked non-forested areas using Rangeland Condition Monitoring Assessment and Projection (RCMAP;

accessed September 2024) data to filter out pixels with less than 10% canopy cover for all years between 1985 and 2023. We then calculated a composite maximum potential distance to seed source for all fires by year and for the decade to account for duplicate and overlapping fires in the NIFC dataset. All processing was done in GEE.

Due to variability in seed dispersal distance, we generated three different scenarios of reforestation need based on published results from the Northwestern and Western US (Laughlin et al. 2023; Buonanduci et al., 2024; Stevens-Rumann and Morgan; 2019): 1) greater than 0 m from seed sources (i.e., all stand-replacing areas), 2) greater than 60 m—the median distance beyond which regeneration is unlikely in Western US forests (e.g., Stevens-Rumann and Morgan, 2019), and 3) greater than 150 m. Although successful regeneration has sometimes been observed at farther distances (e.g., temperate maritime forests - Laughlin et al., 2023), this approach provides a baseline estimate with built-in uncertainty to support initial decision making prior to ground validation and accommodates areas where reforestation need is more likely (i.e., drier, low elevation forests).

We further prioritized current reforestation needs using Potential Vegetation Group (PVG) and heat load using the continuous heat-insolation load index (CHILI; Theobald et al. 2015). PVG was developed for Oregon by classifying Potential Vegetation Type from the Integrated Landscape Assessment Project (Burcsu et al., 2014) into moisture classes (i.e., Cold, Moist, or Dry) based on expert opinion and previous crosswalks developed by the Washington Department of Natural Resources (Povak et al., 2020). CHILI is a continuous index quantifying the effect of slope positioning and latitude on solar heating, which we classified into warm, neutral, and cool based on Theobald et al. (2015). PVG and CHILI together were used to identify areas at risk of regeneration failure: high-priority areas had Dry PVG or Moist PVG on a Warm CHILI site, while low-priority areas had Cold PVG or Moist PVG on Neutral CHILI or Cool CHILI sites. Prioritization was based on need (higher risk equals higher priority); however, survivorship may be lower in high-priority areas as a result.

For each combination of priority, seed zone, region, forest type, and ownership class, we determined reforestation need for each of the three seed distance scenarios and calculated an estimate and uncertainty based on the median, 25th, and 75th percentiles. We chose median to exclude leverage from outliers that might influence the amount of both current and projected reforestation needs, thus exaggerating or underestimating potential seed need.

Projected Reforestation Need

Projected reforestation need was estimated based on current reforestation need from wildfires (see methods above) and scaled based on projected wildfire probability modeled for six downscaled (16 km) GCMs on decadal periods to mid-century (Anderegg et al., 2022). Forest type was used as a predictor variable and assumed to be stationary with future climate change. Other predictor variables used to estimate wildfire probability included monthly temperature, precipitation, and climatic water deficit (CWD). The specific GCMs downscaled by Anderegg et

al. (2022) include: ACCESS-ESM1-5, MRI-ESM2-0, MPI-ESM1-2-LR, CanESM5-CanOE, ACCESS-CM2, and MIROC-ES2L.

We calculated projected reforestation need by multiplying the total acreage of current reforestation need for 2014-2023 by the ratio of mean burn probability from 2014-2023 to mean burn probability for future decadal periods (e.g. 2060-2069) for each GCM for each combination of seed zone, PVG, CHILI, and forest type:

$$\text{Projected Reforestation Need}_{GCM,t} = \left(\frac{\text{Future Burn Probability}_{GCM,t}}{\text{Baseline Burn Probability}_{GCM}}\right) \times \text{Current Reforestation Need}$$

where *GCM* refers to a specific GCM (e.g., ACCESS-CM2), *t* refers to a temporal period (i.e., 2030-2039, 2040-2049), Future Burn Probability$_{GCM,t}$ is the mean fire risk for the given GCM and temporal period, Baseline Burn Probability$_{GCM}$ is the mean fire risk for the baseline period (2014-2023) for the same GCM, and Current Reforestation Need is the total acreage of current reforestation need from 2014-2023. We then calculated the median projected reforestation need among the GCMs for each temporal period. We estimated variance by calculating 10,000 bootstrap samples with replacement for the median for each temporal period. All data was resampled to 30 m to match the spatial extent and resolution of the current reforestation needs estimates. A flow chart for the modeling approach that combines current and projected reforestation need from wildfire can be found in Appendix A (Fig. 1).

Projected Seed Need for Collection

We used expert opinion from ODF scientists and land managers (*personal communications,* ODF, 9 May 2025) to estimate species-specific seedling planting density for each seed zone and forest type for Oregon (Appendix B, Table 1). The average seedlings per pound of seed for the dominant tree species in each forest type were estimated from records provided by Washington Department of Natural Resources scientists (*personal communications*, WADNR, 29 July 2025). These records calculated species wide measurements (Appendix B, Table 2). With this information, we were able to estimate the pounds of seed necessary for each species for current and projected reforestation needs for each forest type and region in Oregon.

Results

Current Reforestation Need – Harvested Areas

Analysis of harvest activities reported in the FERNS and FACTS Timber Harvest databases indicate that, between 2015 and 2023, a total of 499,608 acres of forest land in Oregon were harvested using a practice that would necessitate replanting (Table 1). When broken out by forest type (Fig. 2), Douglas-fir is the most highly harvested type (449,696 acres), of which 81.2% (365,218 acres) occurred in Western Oregon. Ponderosa Pine (11,386 acres) and Red Alder (11,085 acres) were the next most harvested forest types with 97.7% and 99.3% of their harvest occurring in Eastern and Western Oregon respectively. Western Hemlock (6,735 acres) and Grand Fir (6,143 acres) were the fourth and fifth most harvested forest types with 99.3% and

98.5% of their harvest in Eastern and Western Oregon respectively. Finally, Tanoak (4,428 acres), Bigleaf Maple (2,567 acres), and Pacific Madrone (1,657 acres) were the sixth, seventh, and eighth most harvested forest types, with the majority (82.1% and 98.3%) of Tanoak and Pacific Madrone harvest in Southwest Oregon, and 99.2% of Bigleaf Maple harvest in Western Oregon. Across the remaining 23 forest types for which there was harvest, none had more than 1,600 acres of harvest removals over the same period, with a total of 2,594 acres of harvest occurring in Southwestern Oregon, 2,143 acres in Western Oregon, and 1,173 acres of harvest occurring in Eastern Oregon. In total, 77.7% of the harvest area (388,302 acres) was in Western Oregon, 16.6% (83,018 acres) was in Southwest Oregon, and just 5.6% (28,288 acres) was in Eastern Oregon. Harvest activities broken out by seed zone and forest type can be found in Appendix C. The tabular data used for harvest activity results and figures in this document can be found in Appendix D.

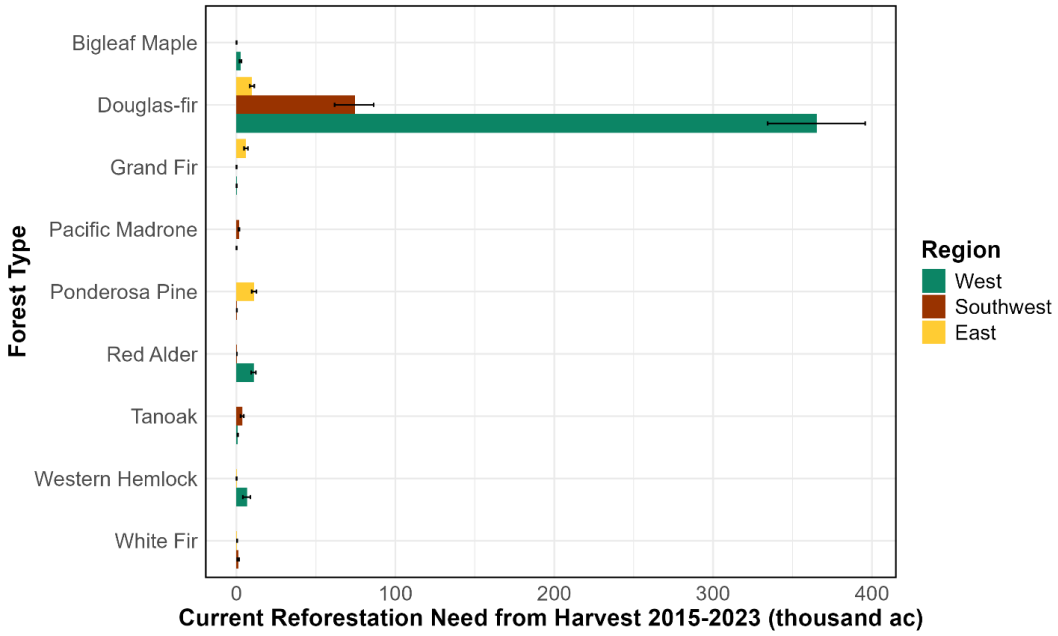

Figure 2. Total acres of harvest (2015-2023) across Oregon by forest type classification and region. Bars represent the sum of all harvest area for a given grouping, and error bars represent the 25th and 75th percentiles of a sample constructed by resampling the data 10,000 times with replacement. Groups with total harvest of less than 1,600 acres are not shown.

The majority (80.5%) of harvest occurs on private industrial lands, of which 22,843 acres is in Eastern Oregon, 69,942 acres is in Southwest Oregon, and 309,518 acres is in Western Oregon (Fig. 3). Harvest is highest in Western Oregon for all ownerships other than the USFS (597 acres in Eastern Oregon,132 acres in Southwest Oregon, 347 acres in Western Oregon). ODF (19,075 acres) and other state agencies (974 acres) account for 4% of the total harvest area across the state. The comparatively low (0.22% of total) harvest on USFS owned and managed lands may be due to differences in data between FACTS (USFS) and FERNS (state, local, tribal, and private) datasets (see Assumptions and Limitations section). However, this result also reflects the fact

that “clearcut style” harvests have become increasingly uncommon on USFS managed lands across the Pacific Northwest following the passage of the Northwest Forest Plan (Spies et al. 2019).

Table 1. Current reforestation need (2015-2023) from post-harvest acres across forest type and regions. Uncertainty is represented by resampling the annual harvest data 10,000 times with replacement and taking half of the interquartile range of the resampled population.

	Harvested Acres (2015-2023)		
Forest Type	**West**	**Southwest**	**East**
Bigleaf Maple	2,547 ± 1,270	20 ± 33	-
California Black Oak	-	659 ± 312	57 ± 74
California Laurel	36 ± 8	19 ± 25	-
California Mixed Conifer	1 ± <0.5	49 ± 23	348 ± 203
Live Oak	77 ± 66	82 ± 32	-
Cottonwood	26 ± 49	-	-
Douglas-fir	365,218 ± 61,404	74588 ± 24637	9,890 ± 2,836
Engelmann Spruce	-	-	5 ± 5
Grand Fir	77 ± 46	14 ± 8	6,052 ± 2,452
Jeffrey Pine	-	18 ± 13	-
Lodgepole Pine	122 ± 37	11 ± 6	244 ± 147
Misc. Western Softwoods	-	57 ± 33	-
Mountain Hemlock	-	-	5 ± 3
Noble Fir	623 ± 593	-	-
Oregon Ash	2 ± 1	-	-
Oregon White Oak	70 ± 34	351 ± 140	5 ± <0.5
Pacific Madrone	29 ± 14	1,629 ± 506	-
Noble Fir	623 ± 593	-	-
Oregon Ash	2 ± 1	-	-
Oregon White Oak	70 ± 34	351 ± 140	5 ± <0.5
Pacific Madrone	29 ± 14	1,629 ± 506	-
Pacific Silver Fir	122 ± 62	-	-
Ponderosa Pine	-	260 ± 224	11,126 ± 3,035
Port-Orford-cedar	59 ± 29	179 ± 99	-
Red Alder	10809 ± 3016	276 ± 75	-
Sitka Spruce	365 ± 115	-	-
Subalpine Fir	-	-	28 ± 15
Sugar Pine	-	7 ± 2	-
Tanoak	792 ± 412	3,636 ± 2,148	-
Western Hemlock	6,688 ± 4,791	-	47 ± 33
Western Juniper	-	-	14 ± 10
Western Larch	-	-	85 ± 85
Western Redcedar	640 ± 318	-	-
White Fir	-	1,163 ± 1,165	381 ± 181
Willow	1 ± <0.5	-	-

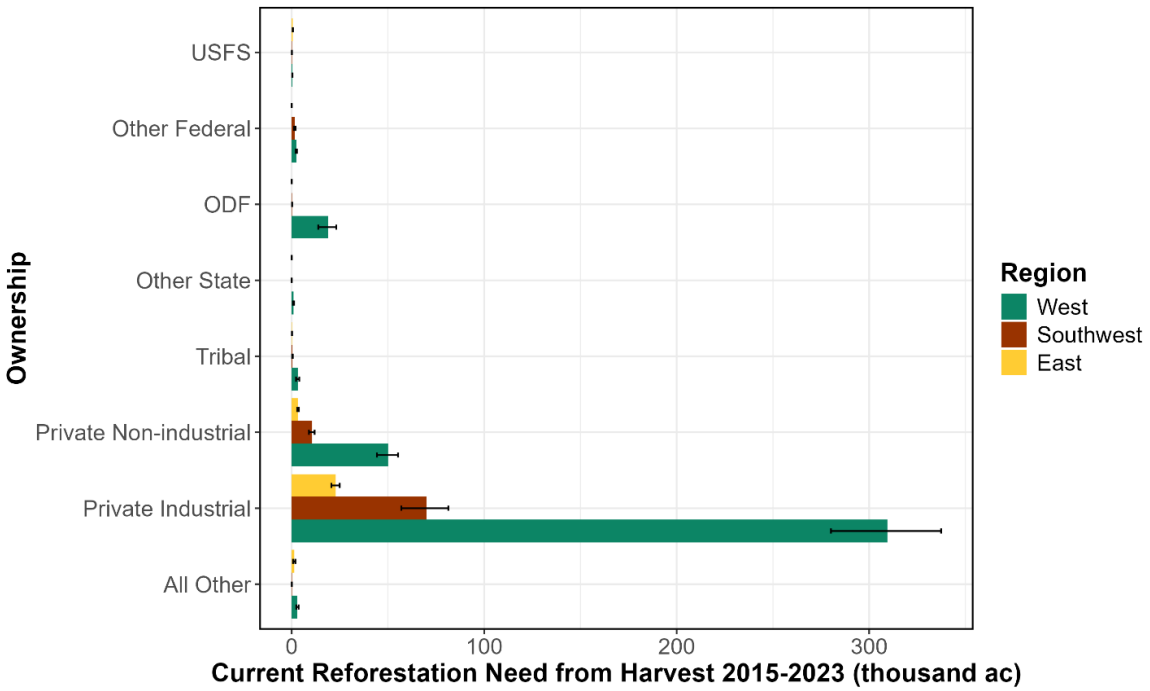

Figure 3. Total acres of harvest (2015-2023) across Oregon by ownership classification and region. Bars represent the sum of all harvest area for a given grouping, and error bars represent the 25th and 75th percentiles of a sample constructed by resampling the data 10,000 times with replacement.

Across our assessment period from 2015-2023 (Fig. 4), annual harvest levels are somewhat stable with an average of 55,512 acres harvested per year. Variation in harvest area is likely driven by prevailing harvested wood product market conditions, and for years like 2021, the volume of timber consumed or converted to salvaged wood as the result of the prior year's fire season. The ratio of harvest by region is also stable, with harvests in Western Oregon accounting for between 76.1% (2021) and 81.1% (2022) of total harvest that year.

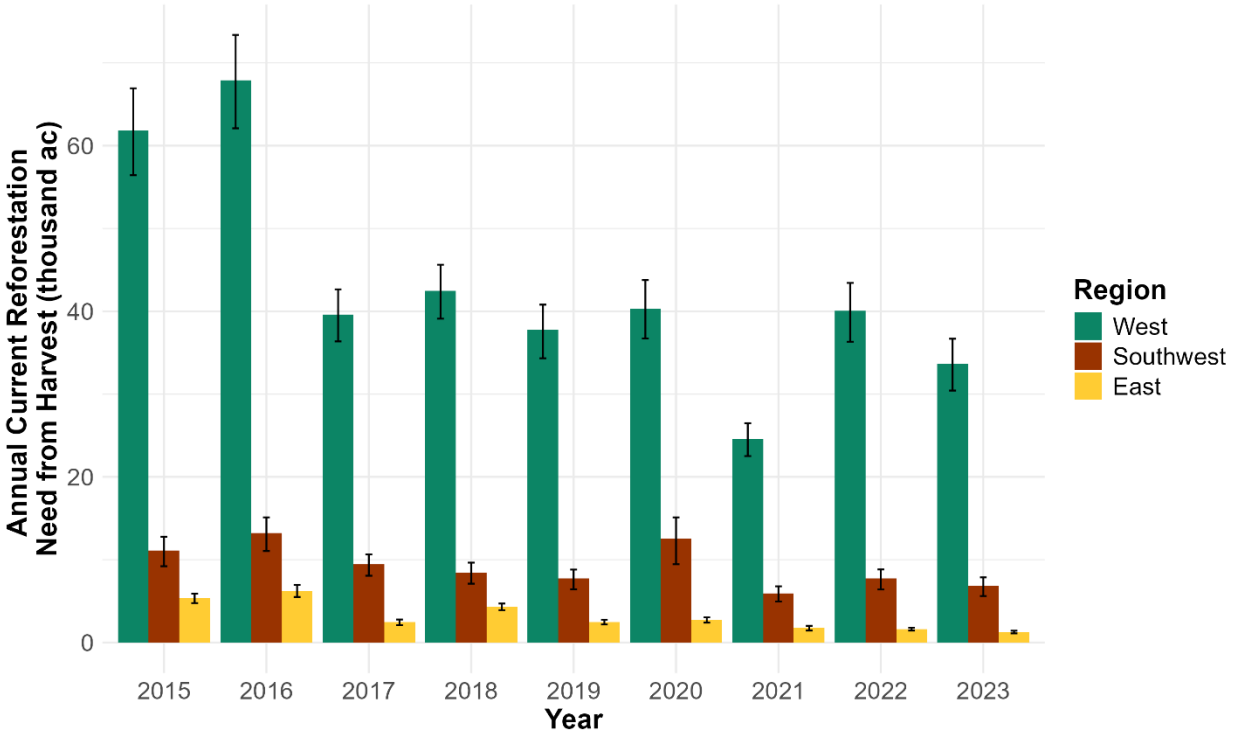

Figure 4. Total annual harvest area (2015-2023) across Oregon by region. Bars represent the sum of all harvest area in a given year, and error bars represent the 25th and 75th percentiles of a sample constructed by resampling the data 10,000 times with replacement.

Current Reforestation Need – Wildfire

Across Oregon, we identified a median of 609,795 acres of cumulative current reforestation need from wildfire between 2014 and 2023. High priority areas comprise 48% (293,746 ac) of the need, versus 52% (316,048 ac) in low priority areas. Cumulative current reforestation need is greater in Eastern Oregon (229,112 ac) than in Southwestern Oregon (191,396 ac) or Western Oregon (189,287 ac); however, there are notable differences between the regions (Fig. 5). For instance, Eastern Oregon has more reforestation need in high priority areas (168,672 ac) than Southwestern Oregon (73,823 ac) or Western Oregon (51,251 ac). Additionally, most of the reforestation need in Western Oregon (92%) and Southwestern Oregon (76%) is in Douglas-fir type forests (174,948 ac and 146,305 ac, respectively), while the greatest need in Eastern Oregon (57%) is in Ponderosa Pine type forests (132,181 ac). Other forest types in Eastern Oregon where notable reforestation need might exist are Lodgepole Pine (29,588 ac), Douglas-fir (23,284 ac), White Fir (13,692 ac), Grand Fir (12,730 ac), and Mountain Hemlock (11,006 ac). Current reforestation need from wildfire by forest type within each seed zone can be found in Appendix C. The tabular data used for results and figures in this document can be found in Appendix E.

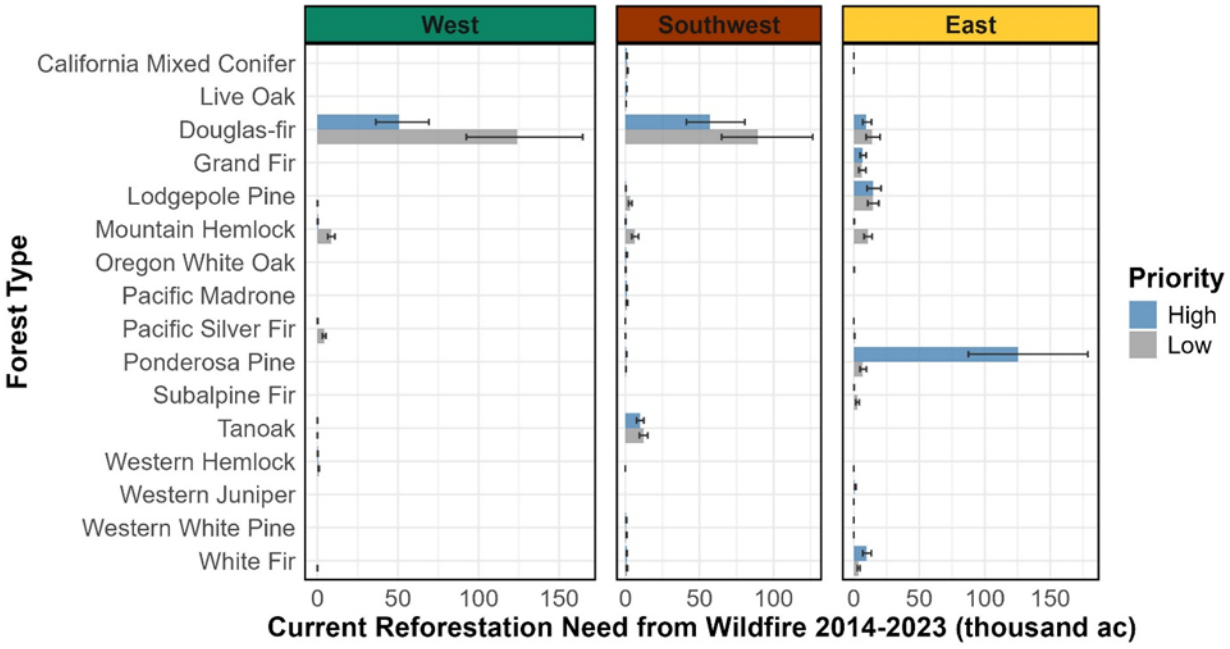

Figure 5. Cumulative current reforestation need from wildfire (2014-2023) across Oregon by forest type, region, and priority. High priority areas had Dry PVG or Moist PVG on Warm CHILI sites. Low priority areas had Cold PVG or Moist PVG on Neutral or Cool CHILI sites. Bars represent the median need calculated using three seed distances, while error lines represent the 25th and 75th percentiles. Forest types having less than 1,000 acres of need are not shown.

In terms of land ownership (Fig. 6), the USFS has the greatest current reforestation need, with 61% (116,687 ac) of the current reforestation need in Western Oregon, 54% (103,041 ac) in Southwestern Oregon, and 66% (151,845 ac) in Eastern Oregon. Private Industrial (43,425 ac) and other Federal agency lands (20,173 ac) also have notable reforestation needs in Western Oregon. Similarly, Southwestern Oregon has substantial needs in Private Industrial (40,505 ac) and on other Federal lands (41,508 ac). In Eastern Oregon, Tribal (22,315 ac), Private Non-industrial (13,558 ac), and Private Industrial (35,445 ac) lands have notable reforestation need. Interestingly for Eastern Oregon, 94% of Private Non-industrial (12,735 ac) and 92% of Private Industrial (32,437 ac) are in high priority areas.

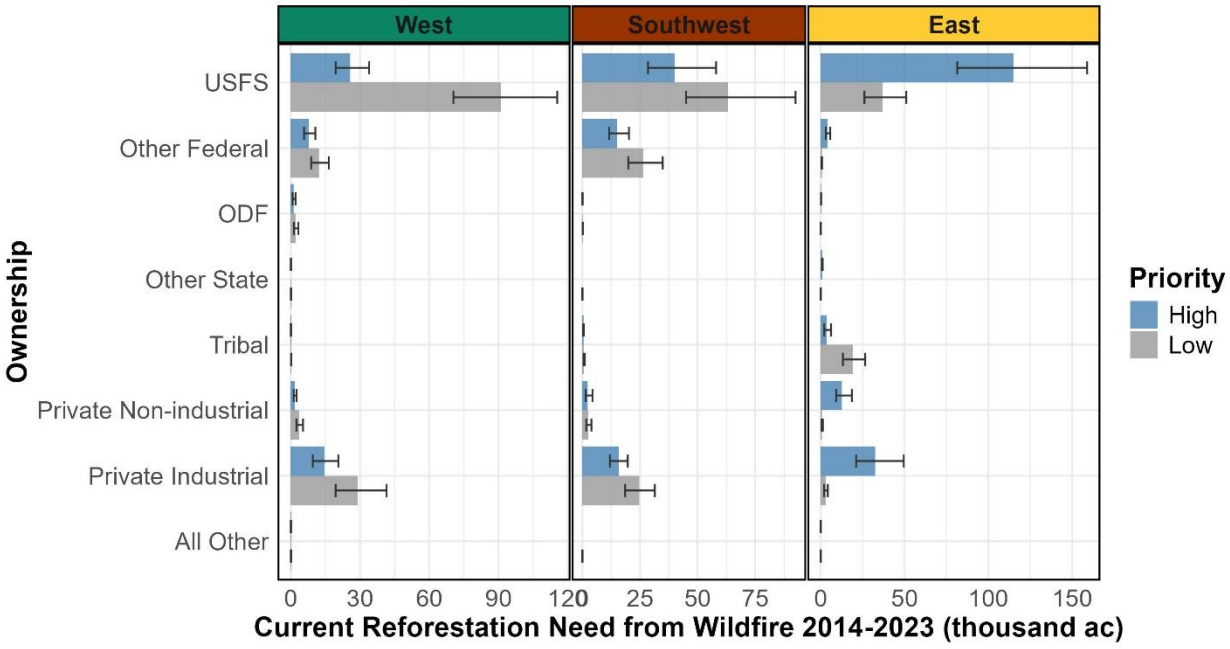

Figure 6. Cumulative current reforestation need from wildfire (2014-2023) across Oregon by ownership and region. Bars represent the median need calculated using three seed distances, while the error lines represent the 25th and 75th percentiles.

Projected Reforestation Need

<The cumulative projected reforestation need for all forest types and priorities for Western Oregon increased from the current reforestation need of 188,890 acres to 1,206,580 acres for the 2060-2069 time period (projected increase of 539%). Eastern Oregon is projected to have a smaller increase than Western Oregon (442%), increasing from the current reforestation need of 227,490 acres to 1,233,520 acres for the 2060-2069 time period. Southwestern Oregon had a comparable increase of projected reforestation need (532%) to Western Oregon with an increase of cumulative acres from the current reforestation need of 186,820 acres to 1,180,740 acres for the 2060-2069 time period. The increase in projected reforestation need in Western and Southwestern Oregon was driven primarily from high- and low-priority Douglas-fir stands, while high-priority Ponderosa Pine stands were the main forest type that increased the projected reforestation need in Eastern Oregon (Fig. 7). Tabular data used for projected reforestation results and figures in this document can be found in Appendix F.

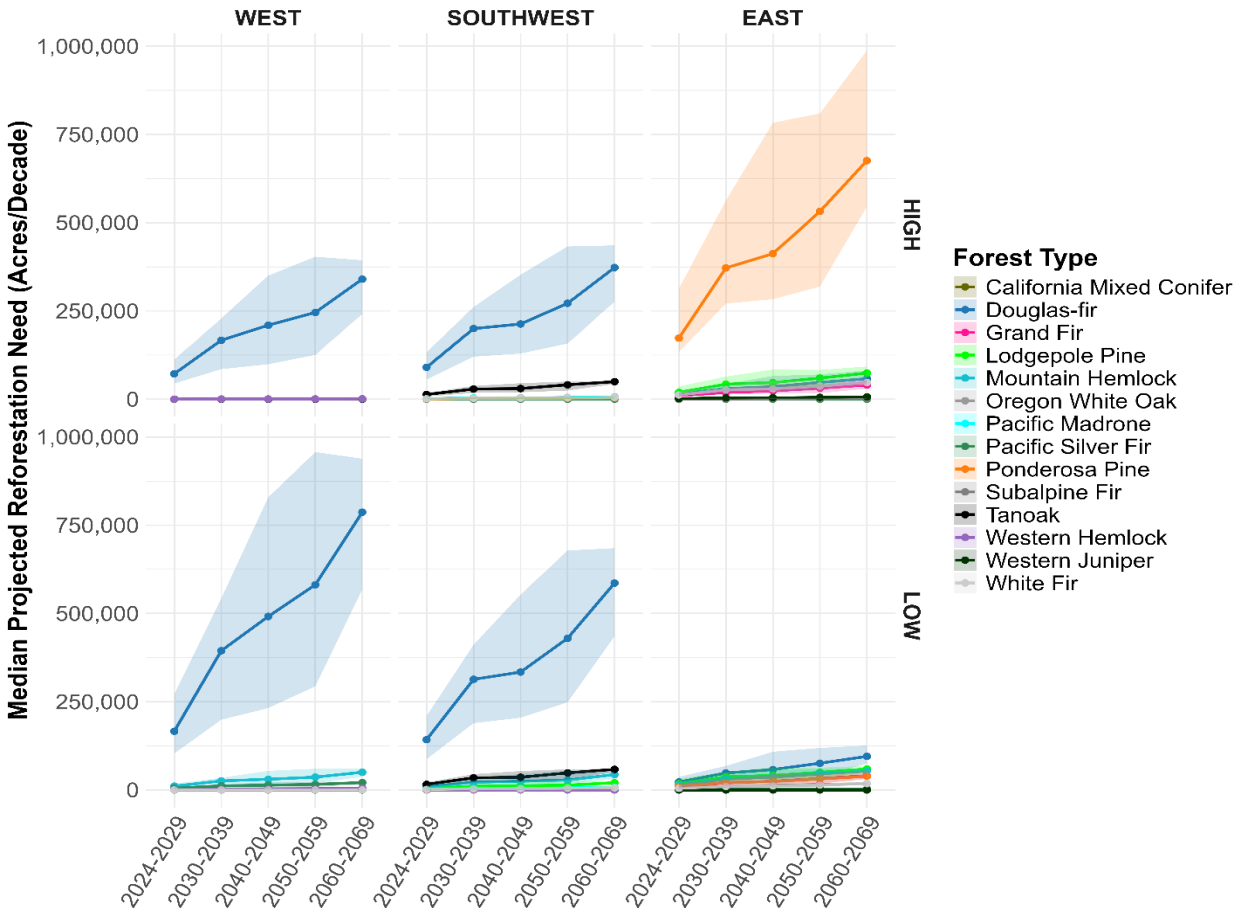

Figure 7. The median projected (2024-2069) reforestation need (acres/decade) among the GCM projections (Shared Socioeconomic Pathway 3) for Western, Southwestern, and Eastern Oregon and high vs. low-priority areas. Error ribbons represent the confidence intervals (95%) of the median of the forest type and decade constructed by resampling the data 10,000 times with replacement.

Overall, the five forest types with the highest projected reforestation need (2060-2069) in Western Oregon included: 1) low-priority Douglas-fir (533% increase since 2014-2023), 2) high-priority Douglas-fir (571% increase), 3) low-priority Mountain Hemlock (491% increase), 4) low-priority Pacific Silver Fir (410% increase), and 5) low-priority Western Hemlock (565% increase). For Eastern Oregon, the five forest types with greatest projected reforestation need (2060-2069) included: 1) high-priority Ponderosa Pine (439% increase since 2014-2023), 2) low-priority Douglas-fir (585% increase), 3) high-priority Lodgepole Pine (397% increase), 4) low-priority Lodgepole Pine (306% increase), and 5) high-priority Douglas Fir (519% increase). Finally, for Southwestern Oregon, the five forest types with greatest projected reforestation need (2060-2069) included: 1) low-priority Douglas-fir (556% increase), 2) high-priority Douglas-fir (554% increase), 3) low-priority Tanoak (377% increase), 4) high-priority Tanoak (397% increase), and 5) low-priority Mountain Hemlock (599% increase). Annually scaled projected reforestation need is provided for all forest types and regions for high-priority (Table 2) and low-priority (Table 3) acreage.

Table 2. Current (2014-2023) and projected (2024-2069) reforestation need (acres/year) for high-priority forest types by region (Western, Southwestern, and Eastern Oregon).

Forest Type - Region	2014-2023	2024-2029	2030-2039	2040-2049	2050-2059	2060-2069
California Mixed Conifer-East	9 ± 3	16 ± 4	20 ± 1	22 ± 8	28 ± 6	35 ± 8
Douglas-fir-East	939 ± 349	2466 ± 786	2989 ± 306	3511 ± 1170	4761 ± 1073	5811 ± 973
Grand Fir-East	673 ± 238	1650 ± 587	1928 ± 246	2350 ± 672	3138 ± 690	4004 ± 687
Lodgepole Pine-East	1491 ± 542	3233 ± 961	4250 ± 373	4712 ± 1821	5978 ± 1311	7417 ± 1163
Mountain Hemlock-East	35 ± 9	67 ± 18	83 ± 6	94 ± 25	111 ± 20	132 ± 13
Oregon White Oak-East	19 ± 16	95 ± 25	110 ± 9	128 ± 45	185 ± 40	220 ± 38
Pacific Silver Fir-East	1 ± 0	2 ± 1	3 ± 0	4 ± 1	5 ± 1	6 ± 1
Ponderosa Pine-East	12543 ± 4553	28847 ± 8287	37180 ± 3418	41221 ± 15610	53197 ± 11735	67566 ± 15127
Subalpine Fir-East	20 ± 14	78 ± 32	91 ± 12	115 ± 34	148 ± 33	186 ± 28
Western Juniper-East	97 ± 58	274 ± 81	363 ± 32	398 ± 160	513 ± 113	665 ± 166
White Fir-East	982 ± 319	2012 ± 590	2656 ± 215	2943 ± 1098	3708 ± 756	4727 ± 921
California Mixed Conifer-Southwest	101 ± 22	213 ± 66	233 ± 6	233 ± 18	242 ± 17	258 ± 11
Douglas-fir-Southwest	5700 ± 1970	15047 ± 4652	19996 ± 2231	21301 ± 8370	27170 ± 9280	37291 ± 4809
Lodgepole Pine-Southwest	33 ± 12	85 ± 22	117 ± 13	133 ± 61	154 ± 50	230 ± 40
Mountain Hemlock-Southwest	21 ± 7	51 ± 14	71 ± 8	80 ± 36	94 ± 31	140 ± 26
Oregon White Oak-Southwest	59 ± 49	285 ± 105	372 ± 70	369 ± 176	492 ± 214	659 ± 128
Pacific Madrone-Southwest	76 ± 35	256 ± 88	316 ± 43	327 ± 124	466 ± 144	598 ± 72
Pacific Silver Fir-Southwest	0 ± 0	1 ± 0	1 ± 0	1 ± 0	1 ± 0	2 ± 0
Ponderosa Pine-Southwest	67 ± 25	161 ± 49	203 ± 29	213 ± 96	276 ± 81	371 ± 97
Tanoak-Southwest	998 ± 246	2225 ± 660	2872 ± 316	3020 ± 840	4086 ± 1054	4964 ± 269
White Fir-Southwest	96 ± 23	211 ± 64	264 ± 24	280 ± 103	364 ± 103	501 ± 74
Douglas-fir-West	5071 ± 1644	11974 ± 3778	16691 ± 2496	20959 ± 8874	24572 ± 8572	34010 ± 4560
Mountain Hemlock-West	16 ± 5	34 ± 9	48 ± 5	56 ± 24	64 ± 20	94 ± 14
Pacific Silver Fir-West	11 ± 4	26 ± 7	35 ± 4	43 ± 18	50 ± 15	68 ± 5
Western Hemlock-West	19 ± 5	34 ± 13	49 ± 8	64 ± 26	81 ± 26	106 ± 15

* Combinations missing from this table (e.g., Engelmann Spruce-West) are not included because they were below the cutoff of >75 acres of current reforestation need or occur in low-priority areas (Table 3). However, this does not mean that these forest types should not be included in management planting strategies.

Table 3. Current (2014-2023) and projected (2024-2069) reforestation need (acres/year) for low-priority forest types by region (Western and Eastern Oregon).

Forest Type - Region	2014-2023	2024-2029	2030-2039	2040-2049	2050-2059	2060-2069
California Mixed Conifer-East	4 ± 1	8 ± 2	9 ± 1	9 ± 3	11 ± 2	14 ± 3
Douglas-fir-East	1389 ± 539	3783 ± 1138	4801 ± 498	5781 ± 2189	7580 ± 1892	9518 ± 1364
Grand Fir-East	600 ± 271	1694 ± 686	2009 ± 268	2478 ± 728	3246 ± 761	4035 ± 723
Lodgepole Pine-East	1468 ± 424	2907 ± 864	3720 ± 260	4108 ± 1224	4979 ± 886	5957 ± 575
Mountain Hemlock-East	1065 ± 306	2335 ± 640	3090 ± 321	3662 ± 1231	4581 ± 979	5344 ± 410
Pacific Silver Fir-East	68 ± 17	144 ± 41	197 ± 20	208 ± 51	242 ± 36	264 ± 19
Ponderosa Pine-East	675 ± 254	1681 ± 481	2123 ± 197	2414 ± 861	3133 ± 697	3879 ± 610
Subalpine Fir-East	284 ± 131	857 ± 361	1017 ± 129	1278 ± 287	1571 ± 306	1772 ± 98
White Fir-East	387 ± 102	786 ± 215	1023 ± 81	1150 ± 406	1409 ± 303	1798 ± 263
California Mixed Conifer-Southwest	158 ± 25	296 ± 90	295 ± 7	295 ± 17	307 ± 16	322 ± 12
Douglas-fir-Southwest	8930 ± 3072	23759 ± 7404	31344 ± 3542	33397 ± 12982	42976 ± 14479	58621 ± 7461
Lodgepole Pine-Southwest	321 ± 110	764 ± 202	1055 ± 116	1189 ± 550	1371 ± 447	2054 ± 361
Mountain Hemlock-Southwest	625 ± 230	1537 ± 419	2167 ± 247	2470 ± 1149	2816 ± 958	4368 ± 775
Oregon White Oak-Southwest	23 ± 11	74 ± 27	94 ± 16	94 ± 43	133 ± 53	173 ± 26
Pacific Madrone-Southwest	99 ± 46	330 ± 110	400 ± 50	415 ± 142	603 ± 172	768 ± 91
Pacific Silver Fir-Southwest	7 ± 4	24 ± 7	35 ± 4	39 ± 17	44 ± 16	68 ± 12
Ponderosa Pine-Southwest	41 ± 14	95 ± 29	120 ± 17	126 ± 57	163 ± 48	219 ± 58
Tanoak-Southwest	1223 ± 278	2651 ± 788	3437 ± 382	3609 ± 997	4841 ± 1225	5836 ± 292
White Fir-Southwest	104 ± 35	270 ± 79	338 ± 33	362 ± 132	479 ± 134	631 ± 90
Douglas-fir-West	12424 ± 3619	27718 ± 9043	39450 ± 5912	49153 ± 20396	58126 ± 19297	78691 ± 11011
Lodgepole Pine-West	4 ± 1	7 ± 2	10 ± 1	11 ± 5	13 ± 4	19 ± 3
Mountain Hemlock-West	851 ± 232	1816 ± 516	2573 ± 288	3045 ± 1291	3639 ± 1144	5029 ± 677
Pacific Silver Fir-West	411 ± 101	837 ± 250	1171 ± 155	1366 ± 532	1600 ± 475	2097 ± 229
Western Hemlock-West	81 ± 26	174 ± 67	256 ± 42	334 ± 137	409 ± 135	539 ± 68
White Fir-West	1 ± 0	2 ± 1	3 ± 0	3 ± 1	3 ± 1	5 ± 1

* Combinations missing from this table (e.g., Engelmann Spruce-West) are not included because they were below the cutoff of >75 acres of current reforestation need or occur in low-priority areas. However, this does not mean that these forest types should not be included in management planting strategies.

Projected Seed Need for Collection

The projected seed need (lbs/decade) necessary to meet typical reforestation projects varied substantially (Fig. 8) but followed the same general trends as the projected reforestation need acreage (Fig. 7). We estimated seed need using projected reforestation need acreage from wildfires and seedling planting densities specific to seed zones by decade, which explains the similar trends between the two analyses. However, seeds for each species varied in successful germination rates and the number of seeds per pound, which was likely the reason why ponderosa pine in high-priority areas in Eastern Oregon have the greatest projected increase from 2014-2023 to 2060-2069 in absolute seed need (439% increase). Douglas-fir seed need increased for high-priority areas in Western (570% increase) and Southwestern (554%) Oregon, as well as for low-priority areas in Western (533%) and Southwestern (558%) Oregon. Also notable is the increase of seed need for Pacific silver fir in low-priority areas in Western Oregon (409%). All other projected seed need information for species and regions can be found in Appendix F.

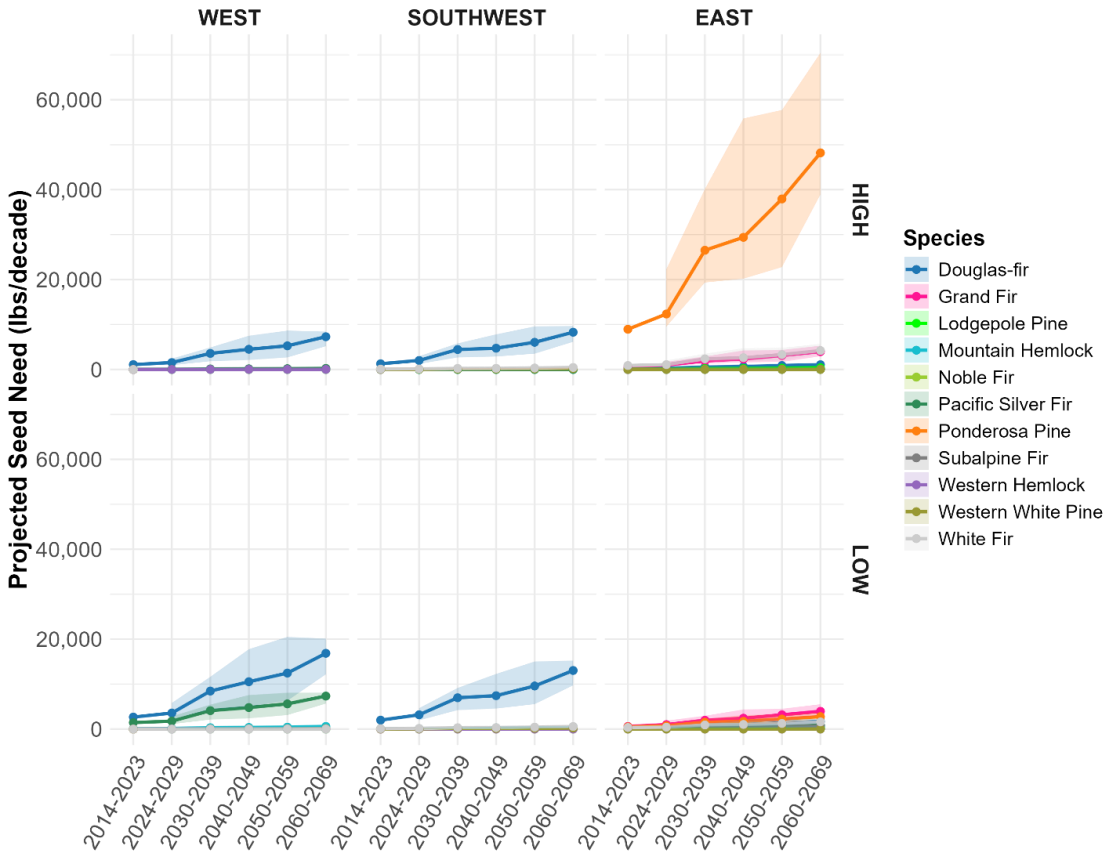

Figure 8. Projected seed need for high- and low-priority areas in the in western, eastern, and southwestern Oregon. Some species are missing because seedlings/lb of seed data was unreliable or missing, and white fir is an average of the other true firs (Abies spp.) in the analysis. Ponderosa pine seed need in high-priority areas in western Oregon are projected to have the most increase in seed need to mid-century. Error ribbons represent the confidence intervals (95%) of the median of the forest type and decade constructed by resampling the data 10,000 times with replacement.

Assumptions and Limitations

For harvest area estimation, the primary limitation stems from the use of public harvest planning data, and the necessity of validating all harvest areas against a forest loss dataset. Submitting a FERNS E-Notification is required prior to conducting forest practices on private and state forest land in Oregon. However, in practice this requirement is not always met, and proposed forest activities do not always go to plan, cover the area proposed, or occur during the proposed period. In addition, FERNS activity categories are broad, and within one activity boundary more than one practice may occur, meaning that it is not always possible to identify where within the proposed area a harvest is occurring. For these reasons, we chose to validate the proposed harvest data against an external forest loss dataset, which brings with it a separate set of limitations and model assumptions. We likely excluded some areas in which harvest has occurred; however, the forest loss dataset did not register a sufficient change in tree cover and thus did not indicate that a forest loss had occurred. Similarly, any harvest not reported occurring outside of a proposed area or occurring before or after the effective expiration dates for the FERNS E-Notification was not included in our estimates.

A secondary limitation, inherent to any examination of reforestation need, is the requirement to establish a cutoff for which practices will necessitate human intervention post-harvest. Our methodology included practices such as clearcuts, while excluding other harvest activities such as shelterwood harvest, where seed trees are left on the landscape to allow for natural regeneration. Within the FERNS E-Notification process, legal definitions for harvest categories are quite broad, which limited our ability to make nuanced distinctions about the specific silvicultural practices taking place. As such, we chose to filter the FERNS data and only consider harvests where “most, or all, conifer timber or large hardwoods will be cut and removed from the unit during harvesting.” The FACTS Timber Harvest dataset contains more information about the exact silvicultural practices which have occurred, which allowed us to only consider true clearcut style harvests, more accurately representing true post-harvest reforestation need on these jurisdictions.

For estimation of current reforestation needs from wildfire, we assumed that no current reforestation was needed for fires before 2014 and that no active reforestation had been completed. These assumptions were based on uncertainty regarding long-term (>10 years) natural regeneration after wildfire and insufficient planting data across ownerships. However, it can be noted that according to FACTS, 30,778 acres were planted in the 60m+ seed distance since 2014 (8% of the USFS current reforestation need). We also assumed that due to policy constraints, reforestation was not needed in Wilderness Areas even if restoration would be beneficial. For some tree species (e.g., lodgepole pine, tanoak), the actual reforestation need could be substantially lower than our estimate because of individual species’ ability to naturally regenerate in stands with complete mortality. We chose not to omit these results because actual species mix within forest types can vary. This analysis represents the best estimate of current need, but ground-truthing will be critical in any reforestation planning effort.

The projected reforestation need analysis relied on multiple assumptions that can influence the final results. For instance, we assumed the forest type from the USFS National Forest Type dataset would stay consistent until the end of our projection period in 2069. We acknowledge that the assemblage of different tree species is likely to change over the next century, with potentially novel forest types emerging as disturbance regimes and climate are altered. We assume that projected reforestation need is strongly linked to projected wildfire probability and does not account for other drivers of widespread mortality events like drought and pathogenic outbreaks. Furthermore, fire footprints from 2014-2023 may not represent different climate zones that might be more susceptible to fire in the future. Our methodology assumes that the proportion and spatial distribution of stand-replacing fire remains consistent over time, although severity and size of wildfires continue to increase on a decadal scale. Stand-replacing patch sizes, wildfire management strategies, and other general forest management strategies might change over the next five decades in a way not reflected in this analysis. Furthermore, since our projections were based on a scaling up of current reforestation needs, any forest type not currently included in those estimates will inherently be excluded from our projections. This does not indicate, however, that those forest types will not experience regeneration challenges and need reforestation in the future.

Additionally, there remains a high amount of disagreement among the GCMs (Appendix G), especially for overestimations of projected reforestation need based on ACCESS-CM2 and CanESM5-CanOEC, which is categorized as a “Too-Hot Model” for the CMIP6 generation of GCMs (Hausfather et al., 2022). In addition, stochastic fire weather events, including intense wind events, can increase fire intensity in Western Oregon and can be detrimental to forests (e.g., 2020 Labor Day Fires in Oregon). These events are extremely difficult to forecast when using burn probability as a metric and are not accounted for in future projections (Dye et al., 2024), although the Labor Day fires were included in the current reforestation need assessment and thus are reflected in the projected reforestation need. If stand-replacing wildfire becomes more common in Western Oregon, then our projected reforestation need would require a reassessment.

Estimating seedlings per pound (lb) for Oregon was challenging and we depended on data and recommendations from multiple experts across the Pacific Northwest. For this study, we used germination rates and pounds per seed estimates from Truettner et al. (2025), except for white fir where we used an average of other true firs (*Abies* spp.). Using a region wide average from nurseries willing to share their information would greatly improve the projected seed need analysis. This is an area where we highly suggest further state- and region-wide data collection efforts, which could include further surveys and/or personal communications with nursery managers.

A significant limitation not fully captured in our current and projected reforestation needs assessment is the ongoing and substantial Douglas-fir die-off occurring in Southwest Oregon (Bennett et al., 2023). The widespread mortality of Douglas-fir results in standing dead timber, which does not trigger reforestation needs based on our current methodology. However, these dead and dying stands represent a future reforestation demand, either through planned salvage harvesting and subsequent planting or as a result of increased wildfire risk and severity in the

region. The ecological and economic impacts of this die-off necessitate consideration in long-term reforestation planning, as the scale of the mortality suggests a considerable future need for intervention that is not reflected in our present or projected estimates, which are primarily driven by harvest and recent and projected wildfire.

Management Implications and Next Steps

This study provides a spatial and temporal analysis of reforestation needs for forested lands in Oregon, highlighting the increasing challenges facing ODF and other land managers as future reforestation needs continue to grow. Our findings emphasize the necessity for strategic and proactive planning and investment in reforestation efforts to maintain forest health, ecosystem services, and timber productivity. Management implications of key findings are further discussed below.

Drivers of Reforestation Need

Western Oregon's reforestation needs are typically driven by timber harvest, but extreme fire events can dramatically increase post-fire reforestation need in the region. The 2020 Labor Day fires account for around 83% of the current reforestation need in Western Oregon from 2014-2023. Comparatively, 28% of the current reforestation need in Southwestern Oregon and 9% of the need in Eastern Oregon were due to the 2020 Labor Day fires. Much of the future reforestation need in Western Oregon will be mandated due to harvest, but the unpredictability and severity of extreme fire weather-driven events (Dye et al., 2024) may prove especially challenging for reforestation planning.

Eastern Oregon’s reforestation needs are driven mainly by wildfire. Our projections suggest reforestation need from wildfire in Eastern Oregon will continue to increase dramatically, up to 442% for 2060-2069 when compared to the current reforestation need (2014-2023). This highlights the necessity for other management considerations, including more fire-resilient forest management and post-fire restoration strategies.

Southwestern Oregon is unique in that both wildfire and harvest are common drivers of reforestation need. With an expected increase of 532% in reforestation needs from wildfire for 2060-2069 and compounding threats from Douglas-fir die-off and sudden oak death, there may be drastic shifts in vegetation composition into the future. These issues will necessitate a portfolio of management solutions with emphasis on landscape scale resilience to multiple disturbances.

Climate Change Considerations

The projected drastic increase in wildfire-driven reforestation need in Eastern Oregon, particularly in Douglas-fir and ponderosa pine forests, indicates profound climate change impacts on reforestation needs. ODF planning should emphasize climate adaptation strategies, including investing in wildfire mitigation and adaptation strategies, promoting forest restoration with genetically-tailored and climate-adapted seed, and developing long-term, strategic forest health and restoration plans that account for changing climate conditions. Strategic plans that

encompass all lands and build upon partnerships can increase capacity, impact, and efficiency to better meet reforestation needs.

The potential effects of climate change also raise questions about shifts in species distribution (Peterson et al., 2014). While the projected reforestation need and associated seed need were based on current forest types, the use of assisted migration may result in seed zone or species shifts across Oregon. In Western and Southwestern Oregon, this could mean increased use of seeds from seed zones for current primary planting species sourced from farther south, or even a shift toward greater inclusion of ponderosa pine. Digital tools like the Seedlot Selection Tool are continuing to increase in extent and species analyzed, and can be used to assist management decisions. Similar shifts are likely in Eastern Oregon, with seed being sourced from farther south or lower elevations, potentially leading to gradual changes in species composition. A key question for future planning is whether trailing edge forests will remain suitable in the future.

Seed and Nursery Capacity

The current reforestation supply chain in Oregon is heavily focused on producing Douglas-fir as the dominant species in Western Oregon and a mixture of ponderosa pine and Douglas-fir for Eastern Oregon. These species are the dominant timber species of the regions, and the availability of both seeds and seedlings is likely correlated with historic demand for each species and seed zone. Ensuring adequate seed is sourced and stored for the appropriate deployment areas, along with maintaining nursery capacity that aligns with future planned and unplanned disturbance reforestation needs, will be crucial in meeting future reforestation demand (Dobrowski et al, 2024). Recommendations include developing a comprehensive seed strategy that prioritizes collection in high-risk, susceptible areas while diversifying seed sources, as well as collaborating with private nurseries and seed banks to ensure adequate supply and increase overall capacity to meet increasing reforestation need.

Prioritization and Resource Allocation

The study provides valuable information for prioritizing reforestation efforts based on seed zones, forest types, and ownership. This can support management decisions to allocate resources strategically, considering the varying needs of different ownerships (e.g., USFS, state, Tribal, private). Decisions can be further supported and aided by data visualizations and a centralized reforestation information resource that is readily and easily available to all stakeholders. Based on the results, American Forests recommends focusing on dry potential vegetation groups and warm CHILI sites, where natural regeneration is less likely to occur. However, high priority areas may also be considered high risk in terms of reforestation survivorship. The objectives of specific management actions should be considered regarding the prioritization scheme outlined in this study. Areas identified as low priority based on moisture and heat index are more likely to regenerate naturally and are lower risk in terms of reforestation survivorship. Strict monitoring protocols and watering strategies should be implemented to increase seedling survivorship in warmer and drier areas.

Data and Monitoring

The limitations of harvest data highlight the need for improved project tracking and monitoring. A comprehensive system for tracking harvest data across land ownerships could help refine and improve the accuracy of estimated reforestation need from harvest. Similarly, more regeneration surveys and post-planting monitoring can better inform and provide more accurate estimates of post-fire reforestation need and outcomes. Monitoring efforts that collect information on planting outcomes can provide timely updates to reforestation needs that consider both the successful planting efforts and areas that fail and require re-entry. Monitoring can further provide insight into the utility of specific planting plans and approaches, facilitating adaptive management approaches, and increasing the probability of successful reforestation given expected changes to climate change and wildfire regimes.

Collaboration and Partnerships

Addressing increasing reforestation needs requires collaboration with various stakeholders, including federal agencies, Tribes, private landowners, nonprofits, and research institutions. ODF may benefit from continuing to foster strong partnerships to leverage resources and expertise and increase capacity to meet this ongoing issue. Continued and increased public outreach and education to promote reforestation awareness is important to keep the public engaged, informed, and supportive of reforestation efforts and policies.

Recommended Next Steps

1. **Develop a long-term reforestation strategic plan:** This plan should incorporate climate change projections, prioritize high-risk areas, and outline strategies for seed collection, nursery capacity, and resource allocation. It should include building partnerships and collaborative efforts.
2. **Invest in wildfire adaptation strategies:** This includes fuel reduction, prescribed burning, and community wildfire preparedness.
3. **Improve data collection and monitoring:** This includes enhancing data and resource sharing with private landowners and developing a comprehensive reforestation resource that is accessible to all.
4. **Foster collaboration and partnerships:** This involves engaging with federal agencies, Tribal governments, private landowners, nonprofits, and research institutions as well as those who work in all sectors of the reforestation pipeline, such as seed extractories, nurseries, reforestation service providers, and cone collectors.
5. **Prioritize funding:** Seek and allocate funding to support reforestation efforts, wildfire risk reduction and resilience, climate adaptation, partnership building and collaboration, and public engagement and awareness.

By implementing these recommendations, ODF can more effectively address increasing reforestation challenges and improve the resilience of Oregon's forests.

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Nursery Capacity, Limitations, and Recommendations for Oregon

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Abstract

Background: The Pacific Northwest faces escalating reforestation needs, currently estimated at 2.073 million acres in Oregon and Washington, driven by intensifying wildfires and timber harvest. This report synthesizes findings from surveys conducted from fall 2024 to winter 2025 with nurseries serving this region, aiming to deepen understanding of their capacity, challenges, and recommendations to support the industry in meeting current and projected reforestation demands.

Results: Surveyed nurseries report a total annual seedling capacity ranging from 162.75 million to 284.75 million seedlings, with many operating at or near maximum utilization, particularly for container stock. While latent capacity for expansion exists (62% can expand beyond limits), this is largely hindered by uncertainty of future demand, infrastructure constraints, labor availability, and inconsistent ordering patterns. Container seedling capacity is highly utilized, while bareroot capacity is increasingly underutilized, suggesting a market shift. Furthermore, seed inventory, especially for conifers, is modest (most have two years or less), with fire restoration planting having depleted supplies.

Conclusion: Nurseries are largely operating at their desired capacity, and expansion is contingent upon greater certainty, long-term contracts, and demonstrable increases in consistent demand. Key recommendations to support the industry include developing strategic planning with long-term contracts, fostering greater collaboration and knowledge sharing across the reforestation supply chain, conducting continued research to understand the disconnect between need and demand, and establishing a formal reforestation network to optimize seed supply, develop the workforce, and build critical partnerships. Addressing these areas will enable the nursery industry to enhance its capacity and contribute more effectively to successful forest restoration efforts.

Keywords: nursery capacity, seedlings, reforestation, Pacific Northwest, wildfires, seed supply, long-term contracts, forest restoration

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Introduction

The intensifying wildfire regime in the Pacific Northwest coupled with timber harvest as a key economic driver in the region necessitates a thorough evaluation of existing and potential reforestation capacity to address the escalating reforestation needs. This report contributes to a broader data assessment quantifying current and projected reforestation needs in Oregon and Washington, which estimates a substantial 817,000 acres within wildfire scars with limited potential for natural regeneration (i.e., >60m from viable seed sources), and 1.275 million acres of post-harvest reforestation need, which equates to a total of 2.092 million acres across Oregon and Washington for estimated current reforestation need. While this report is for Oregon, it is important to consider this need across state lines as many nurseries work across state lines, and this impacts the overall capacity for reforestation in the Pacific Northwest.

Historically, reforestation efforts focused on regenerating harvested areas, but a decline in timber harvests in the 1970s through 1990s coupled with recent increases in wildfire extent, frequency, and area burned at high-severity, has led to post-fire restoration emerging as a dominant factor influencing reforestation needs in the Western United States (Parks and Abatzoglou, 2020; Haugo et al., 2019; Halofsky et al., 2018; Dumroese et al., 2005) and accounts for a substantial proportion of the demand (e.g., 81% on National Forest System lands ; USDA Forest Service 2022).

Concurrently, reforestation in Oregon remains significantly influenced by regulatory requirements following timber harvest, a key economic sector contributing to employment and wages (Oregon Employment Department, 2025). The Oregon Forest Practices Act mandates reforestation after significant timber removal, establishing a consistent demand, particularly in Western Oregon (Oregon Department of Forestry, 2024).

Addressing the multifaceted drivers of reforestation demand necessitates not only accurate estimations of current and future reforestation needs, but also a comprehensive understanding of the logistical and operational constraints of nurseries who grow the seedlings for reforestation efforts. This report presents findings from research employing surveys to nurseries conducted from fall 2024 to winter 2025. The objective was to deepen the understanding around capacity, challenges, and obstacles encountered by nurseries that serve Oregon and Washington, and glean their recommendations on how to better support their industry. The overarching objective of this research is to provide insights that can inform the development of evidence-based strategies and policies aimed at supporting the reforestation industry's capacity to effectively address current and projected reforestation demands in the Pacific Northwest.

Methods

In the fall and winter of 2024, a survey was sent to nurseries serving Oregon and Washington to better understand their current capacity to provide seedlings for reforestation efforts across the Pacific Northwest region, the challenges they might face in meeting current and future demand,

and their potential for expansion. Nurseries were identified in consultation with the Washington Department of Natural Resources (DNR), Oregon Department of Forestry (ODF) and the US Forest Service Reforestation, Nurseries, and Genetic Resources (RNGR) program. American Forests developed the survey with feedback from Washington DNR, Oregon Department of Forestry, and Sustainable Northwest on the content. The survey was developed using GoogleForms and was emailed with a link for responses to the list of providers (n=138). Surveys were also distributed via QR code at conferences and through partners to relevant contacts. We received 26 responses, including one representing four nurseries. Of the respondents, 12 were based in Oregon, 8 in Washington, and the rest in neighboring regions, including California, Idaho, and Canada.

The surveys were designed to broadly capture nursery capacity. It is important to note that any more detailed or species-specific information regarding nursery stock, production practices, seed collection practices, or specific challenges would necessitate follow-up, in-depth surveys directly with individual nurseries. Furthermore, this study did not include seed orchards, which play a critical role in the overall reforestation supply chain. For a more comprehensive understanding of regional seed capacity and current status, further exploration and dedicated surveys of seed orchards would be required. The results of this survey do not represent the entirety of nursery capacity across Oregon, as not every nursery that supplies seedlings to the state responded. However, they provide valuable insights into the current capacity of participating nurseries, their potential for expansion, the limitations they may face, and recommendations to better support the nursery industry. Please refer to Appendix A to see a copy of the survey.

Results

General Information and Operations

The majority of respondents (73%) represented private nurseries (19), with the remainder representing nonprofit organizations (3), federal (2), tribal (2), and state (1). The nurseries serve a diverse range of markets, including public agencies, private industry, small woodland owners, and tribal entities.

When asked which species they grow, most nurseries grow conifers, with Douglas-fir (92%), ponderosa pine (89%), western red cedar (81%), and western hemlock (77%) being the most common species grown by respondents.

Total Capacity

The total annual seedling capacity, calculated by summing the minimum and maximum values of all response ranges, is 162,750,000 to 284,750,000 seedlings. It is important to note that not all nurseries responded to the survey, therefore this is not reflective of total capacity across Washington and Oregon, it is rather a reflection of overall capacity of all of those that responded.

Many of the respondents (44%) are currently operating at over 75% of their total maximum capacity, with an additional 20% reporting they are at full capacity. A smaller percentage of respondents indicated lower utilization rates, with only 8% operating at less than 25% capacity and 16% between 25-50% capacity (Figure 9). Several respondents provided additional context. One noted that "capacity is dependent upon labor availability, not growing space," while another remarked on dual constraints; that their “capacity is limited by space and staffing." One respondent indicated a potential for growth, stating, "With orders we will build more nurseries." However, the need for reduced risk when increasing capacity was also highlighted: “Any increases in production will require a contract or other method to limit risk.”

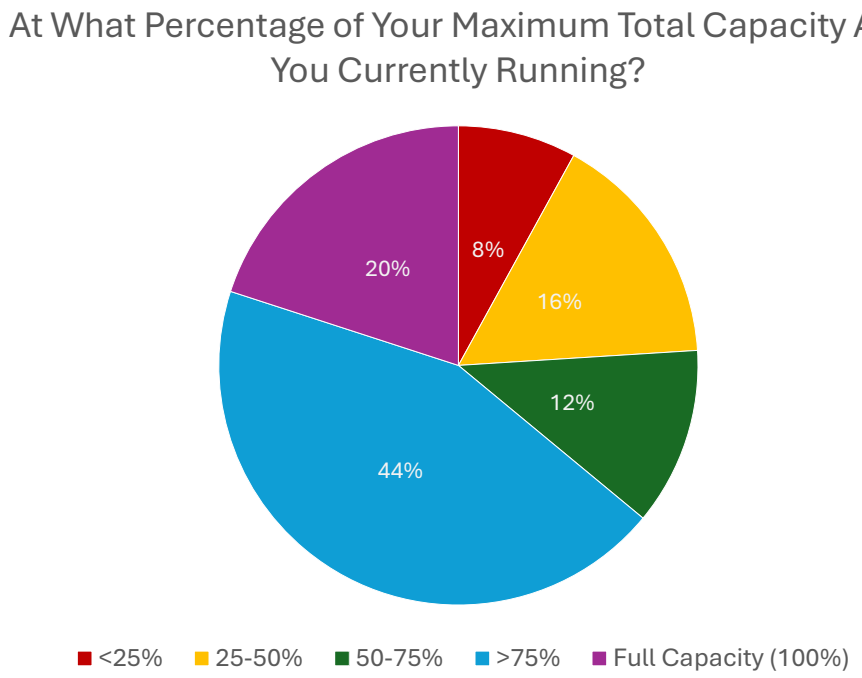

Figure 9. Maximum Total Capacity Utilized

Bareroot Capacity

Of the respondents, 5 do not grow bareroot seedlings. Of those that do grow bareroot seedlings, 5 reported an annual bareroot seedling capacity of up to 250,000, 2 had a capacity between 250,000 and 1,000,000, 5 reported a capacity of 1,000,000 – 5,000,000, 4 had a capacity of 5,000,000 to 10,000,000, and 2 had a maximum annual capacity between 10,000,000 and 20,000,000 seedlings (Figure 10).

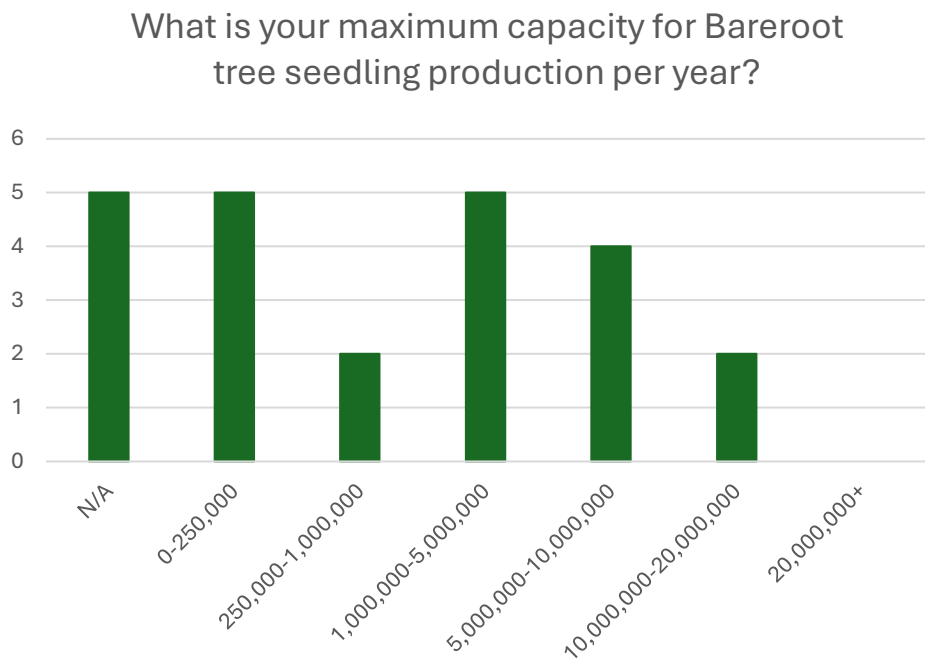

Figure 10. Maximum Bareroot Seedling Capacity

Regarding the utilization of this capacity, 30% of respondents indicated they are operating at over 75% capacity, and 20% are at full capacity. Notably, 45% of respondents reported utilizing less than 50% of their available bareroot capacity (Figure 11). This underutilization aligns with the comment: “Our container capacity is near max most years, but bareroot capacity is very underutilized.” This suggests a potential decrease in bareroot orders. One respondent elaborated on the potential, stating, “We could easily grow 5 million bareroot seedlings per year. Most of our clients have switched to container which is not the best stock type for our harsher sites.” The general sentiment suggests that "bareroot seedling capacity is underutilized and could increase," likely due to a shift in demand toward container stock types.

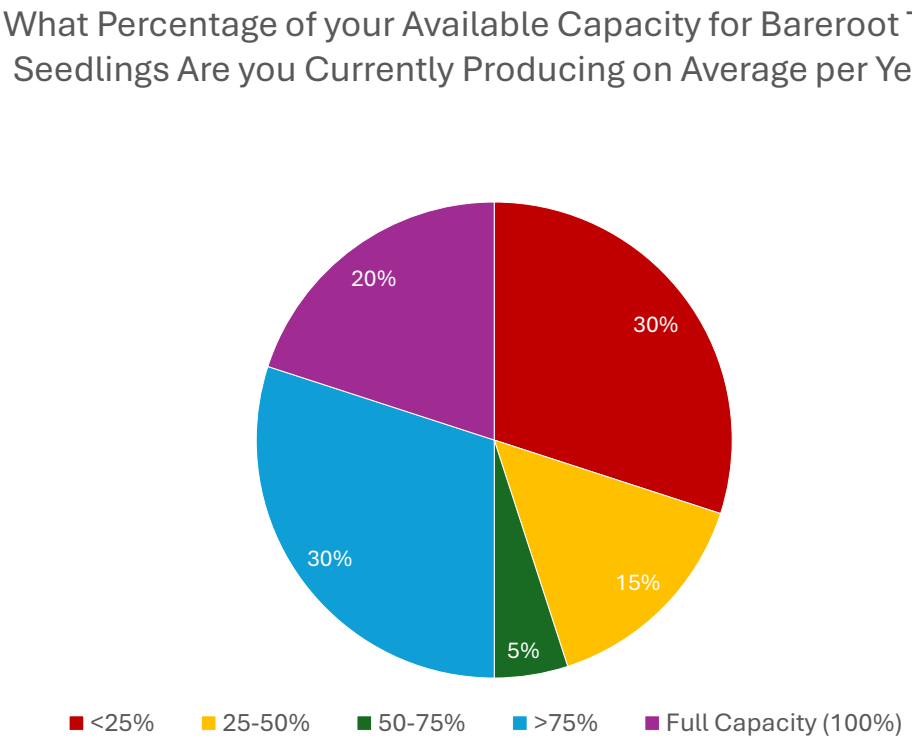

Figure 11. Bareroot Seedling Capacity Utilization

Container Capacity

Out of 26 responses, 2 nurseries do not grow container seedlings, 5 respondents reported a container seedling capacity of up to 250,000 annually, 5 had a capacity between 250,000 and 1,000,000, 6 reported a capacity of 1,000,000 – 5,000,000, 2 had a capacity of 5,000,000 to 10,000,000, 2 were between 10,000,000 and 20,000,000, and 4 respondents indicated a capacity of over 20,000,000 container seedlings annually (Figure 12).

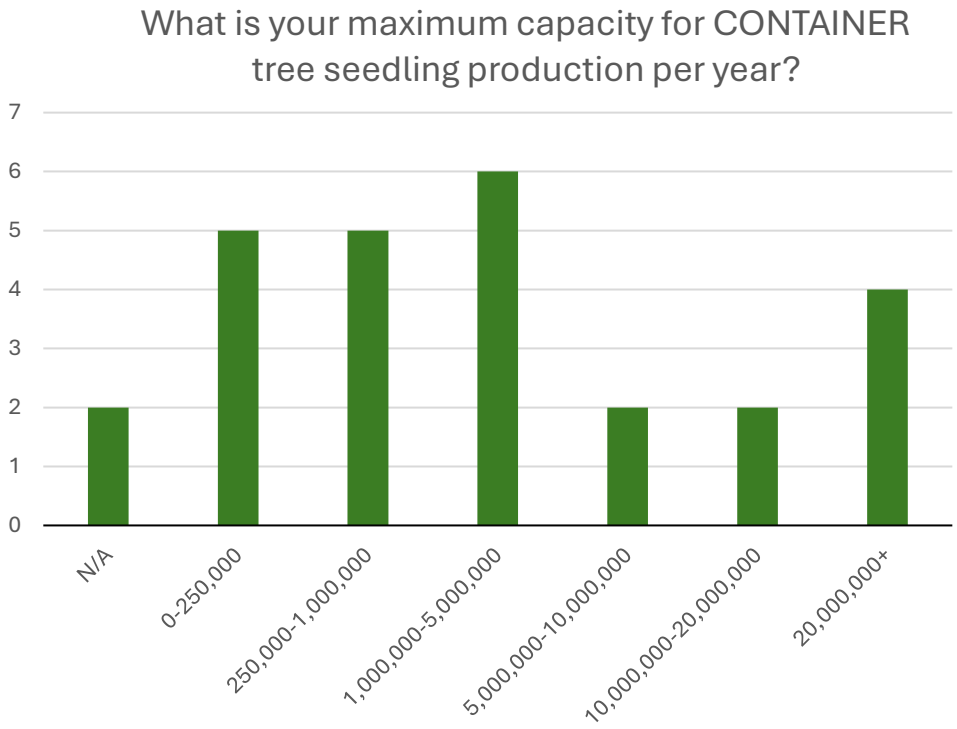

Figure 12. Maximum Container Seedling Capacity

In terms of capacity utilization, 33% of respondents indicated they are using over 75% of their container capacity, and 25% reported operating at full capacity. In contrast, only 21% of respondents indicated they are using 50% or less of their available container capacity, on average (Figure 13). This higher utilization is reflected in the comment: “Our container capacity is near max most years...” Furthermore, one respondent indicated an increasing trend: “Growing more plants in the Greenhouses. We have a lot of capacity for new customers” and another mentioned, "...there are increases in container orders." The remarks that container orders are increasing while bareroot capacity is underutilized suggests a potential mismatch between current production capacity and market demand. This trend may indicate a need for nurseries to potentially shift resources towards increasing container seedling capacity to meet the growing demand for that stock type.

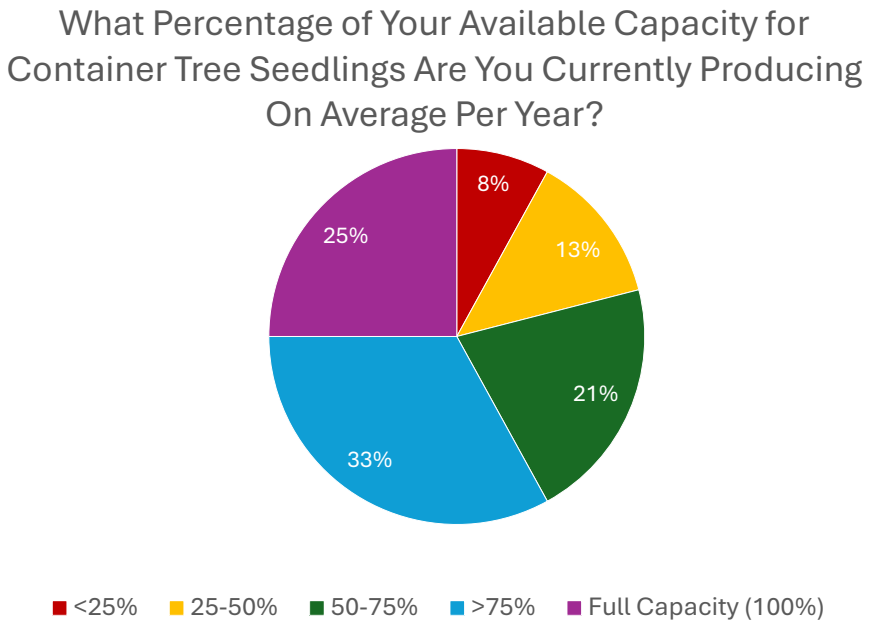

Figure 13. Container Seedling Capacity Utilization

Expansion Potential and Limitations

While many respondents indicated they were operating at over 75% of their total maximum capacity, 62% reported having the ability to expand beyond their current operational limits (Figure 14), and an even larger 69% indicated they could increase production to meet growing orders within their existing facility capacity (Figure 15). This suggests a latent capacity within the sector.

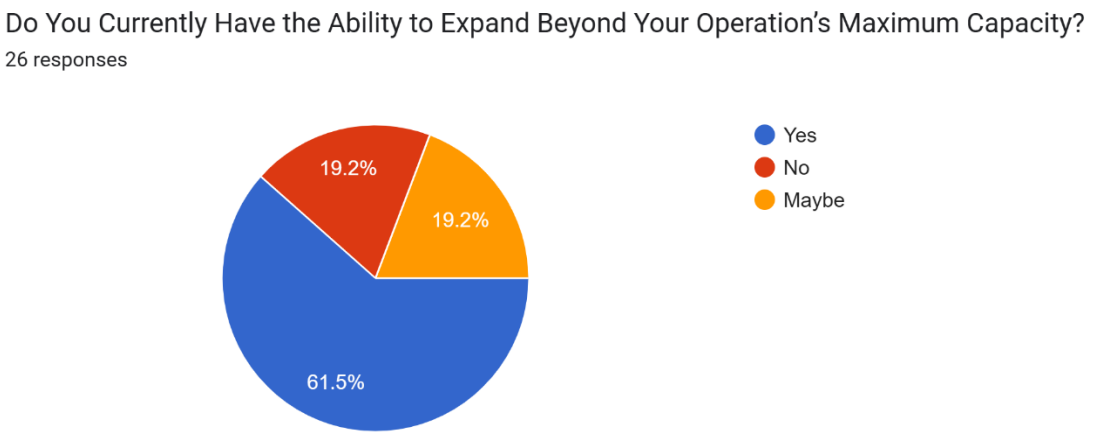

Figure 14. Ability to Expand Beyond Maximum Capacity

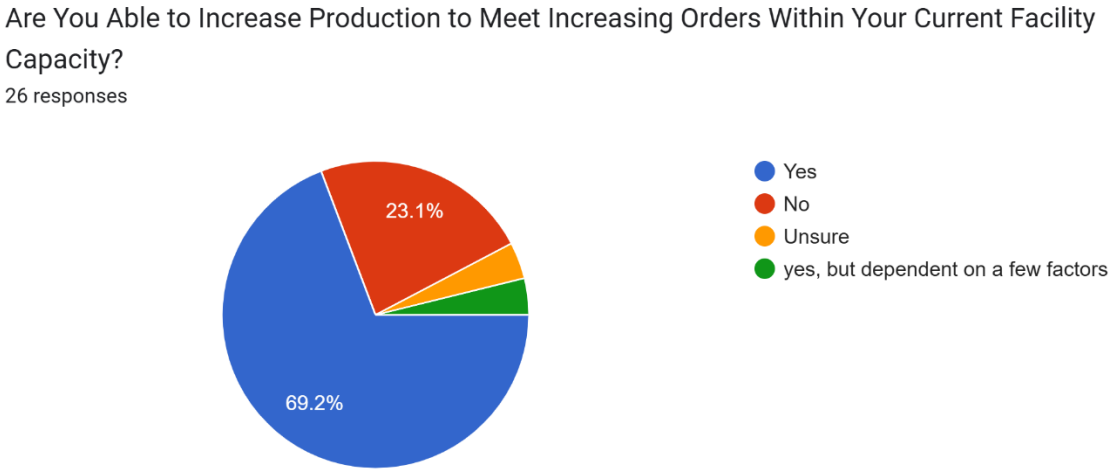

Figure 15. Ability to Increase Production to Meet Increasing Orders within Current Capacity

When elaborating on their ability to expand, respondents cited various factors. Some highlighted their existing capabilities and resources: “We have the ability to quickly increase infrastructure,” “We are looking to build a new site,” “We're good at building nurseries,” “We have an extra can yard that we could put containers outside,” “We have open ground. Plenty of open space,” and “5

acres already purchased but not cropped." Others discussed historical capacity and potential: "Historically we produced 20 million Bareroot seedlings in the 1980s. If federal demand were to increase, we could comfortably increase to 5 million per year and have the capacity to do 10 million," and "Historically the nursery has added capacity to meet market demand, we have land and resources to do so again if the seedling demand required it."

However, limitations also exist. When asked what the limitations were for expansion, the largest response was the uncertainty of future demand, followed by infrastructure, full time labor, and inconsistent ordering patterns (Figure 16).

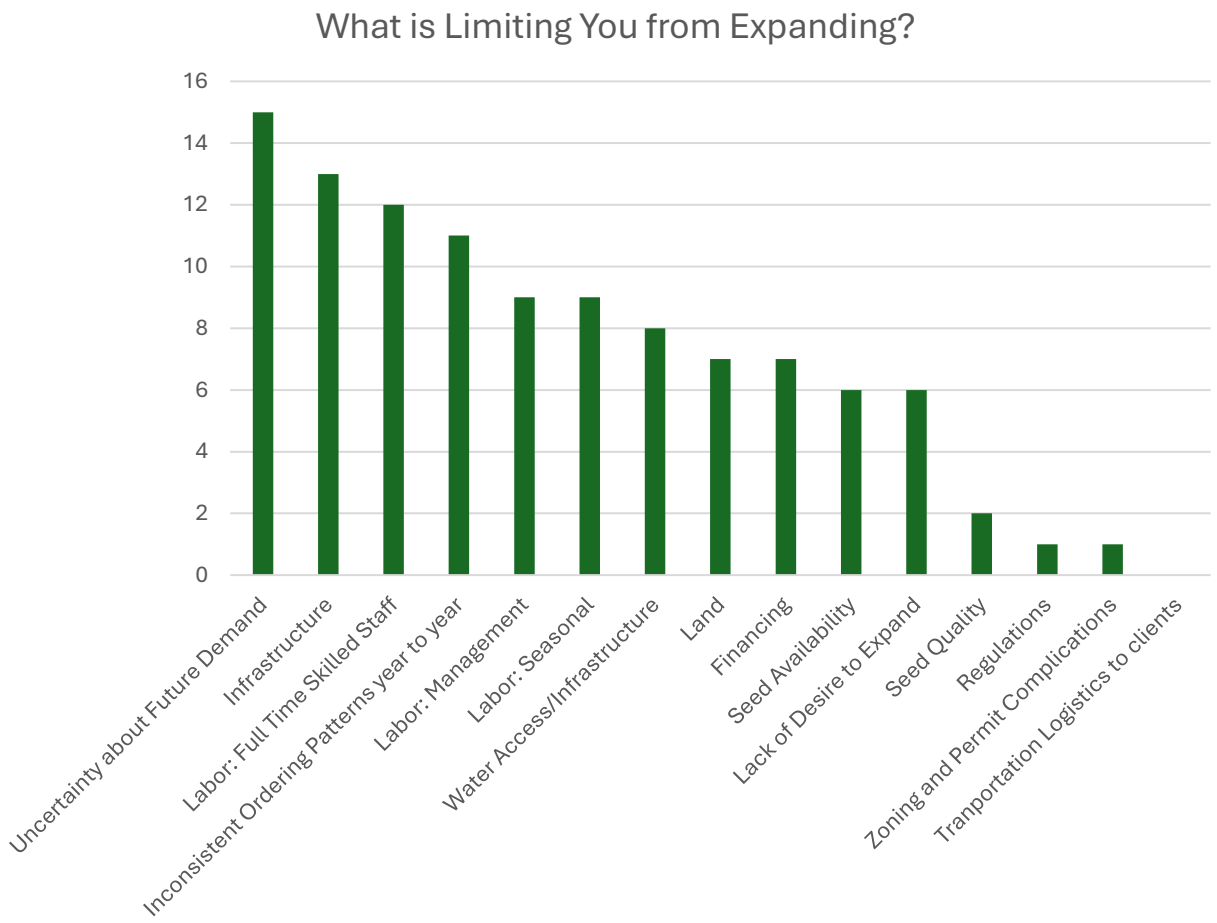

Figure 16. Limitations to Expanding

Several respondents elaborated on expansion constraints. Regarding infrastructure and staffing the following comments were included: "Our nursery is in an active flood plain which limits our ability to expand. We have looked at a few possibilities to expand a bit, but we are still limited by

staff and funding," "Out of space," "Labor and hiring issues," "if we had more personnel we could expand," and "It basically comes down to labor. It's not as easy for us to hire additional labor especially given the fact that {our location} does not have affordable housing." Another highlighted the cost to adjust to container stock type: "There is a plan to increase containerized capacity but will depend on funding."

The uncertainty of future demand was a recurring theme when asked about limitations and concerns with expansion: "Uncertainty about future demand," "Give us long term contracts and we'll spend money to expand," "We expanded rapidly. We are waiting for market demand to increase before expanding more," and "What direction is the market going? What is the economy going to do? We have the capacity to take on new customers when they are ready." The need for assurances, longer term commitments, and consistent market trends was also emphasized: "Funds are available for expansion if market needs are shown and have tied expansion to multi-year commitments in the past at other nursery sites," "Expansion may be possible but only with adequate assurances and support," "We hear a lot about future increasing demand but we are not seeing any increase in orders yet," and "Seed supply and our ability to find appropriate seed sources to purchase, getting contracts for orders a year in advance rather than a month or two before folks need them and we are sold out by that point."

Finally, some respondents indicated they are currently meeting demand and do not see a need for expansion: "We can grow and contract easily based on orders", "We currently have extra ground for production so until that is fully utilized we are not considering expanding," and "I think we have positioned ourselves to meet Federal expansion of reforestation efforts." As one respondent succinctly put it: "Why would we want to expand?"

When asked if grants would prompt nurseries to increase capacity for reforestation, 50% responded yes, and 39% responded maybe, with only 12% saying no (Figure 17).

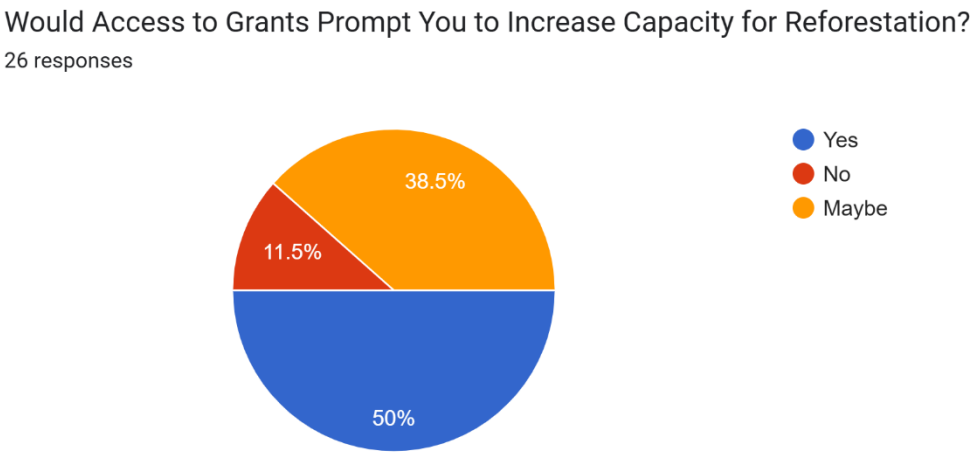

Figure 17. Would grants prompt you to increase capacity?

Bareroot Expansion Potential

Expansion potential for bareroot seedlings beyond current capacity varied considerably, with many respondents either not growing or expressing no interest in expanding bareroot production (46%). However, for those wanting to expand, most indicated a potential increase in the range of 10-25% (Figure 18).

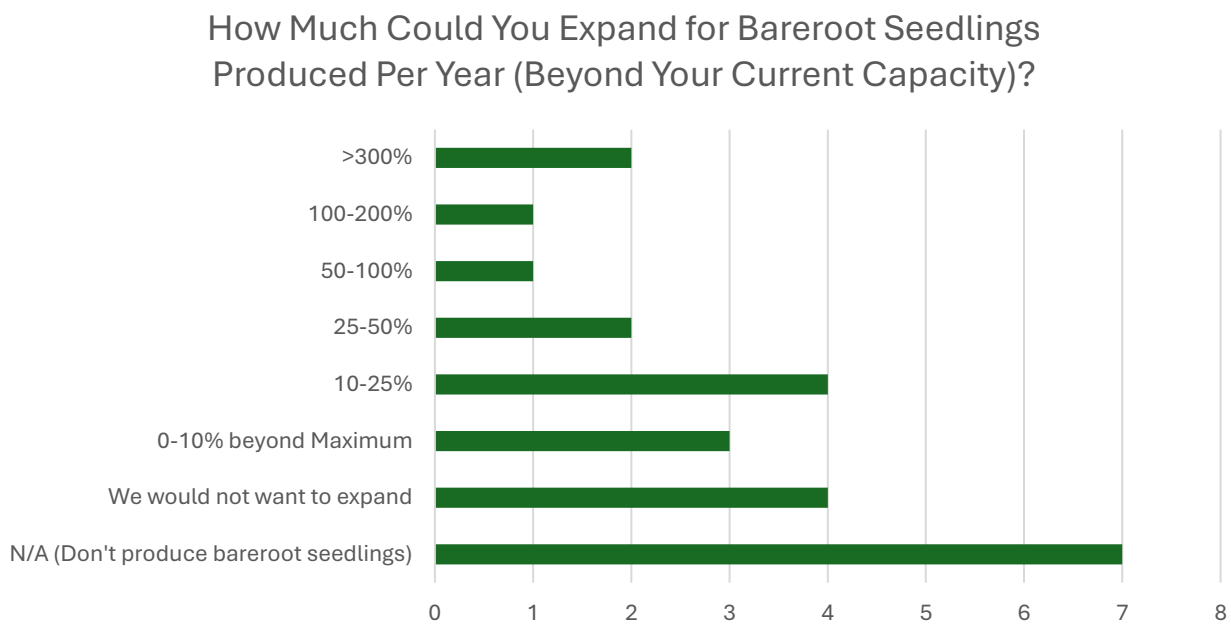

Figure 18. Bareroot Expansion Potential (Percentage)

Numerically, the total potential annual expansion for bareroot seedlings across all responses ranges from 20,200,000 to 55,200,000 seedlings (Figure 19). One respondent noted, “To get back to historic levels of 20 million some of the fields would have to be cleared of native seed production plots.” This highlights that while potential exists, it may require specific actions or market conditions, and most are not wanting to expand for bareroot seedlings under current conditions and ordering trends.

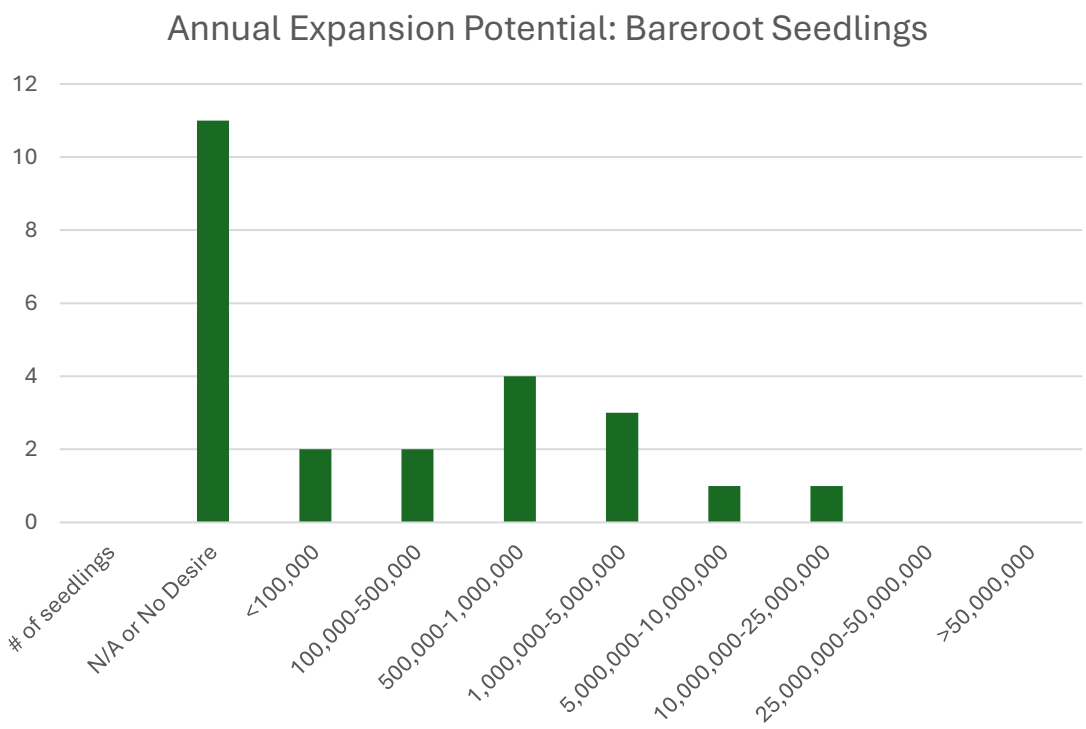

Figure 19. Annual Bareroot Potential Expansion (Seedlings)

Container Expansion Potential

There was a wide range in the reported potential for expanding container seedling production beyond current maximum capacity, with most respondents (27%) falling within the 10-25% expansion range (Figure 20).

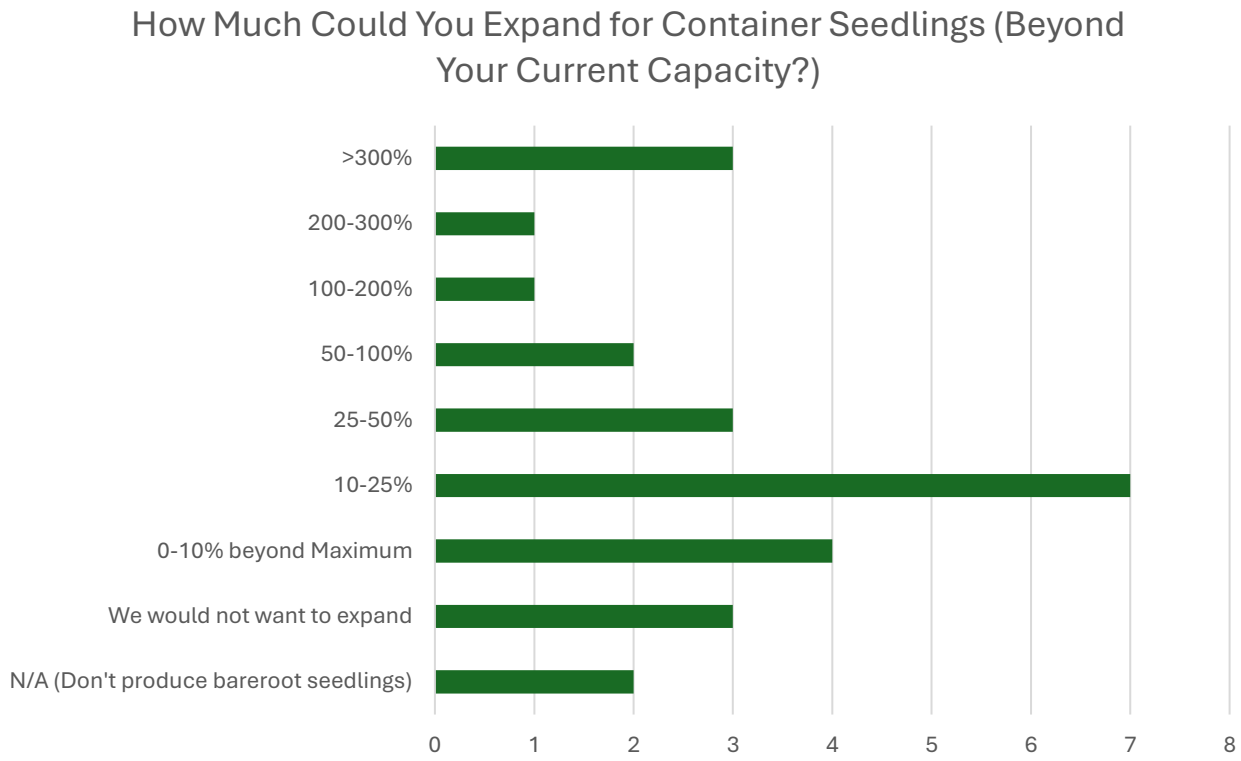

Figure 20. Container Expansion Potential (Percentage)

Based on these responses, the total potential annual expansion for container seedlings across all responses is estimated to be between 140,700,000 and 195,800,000 seedlings per year (Figure 21).

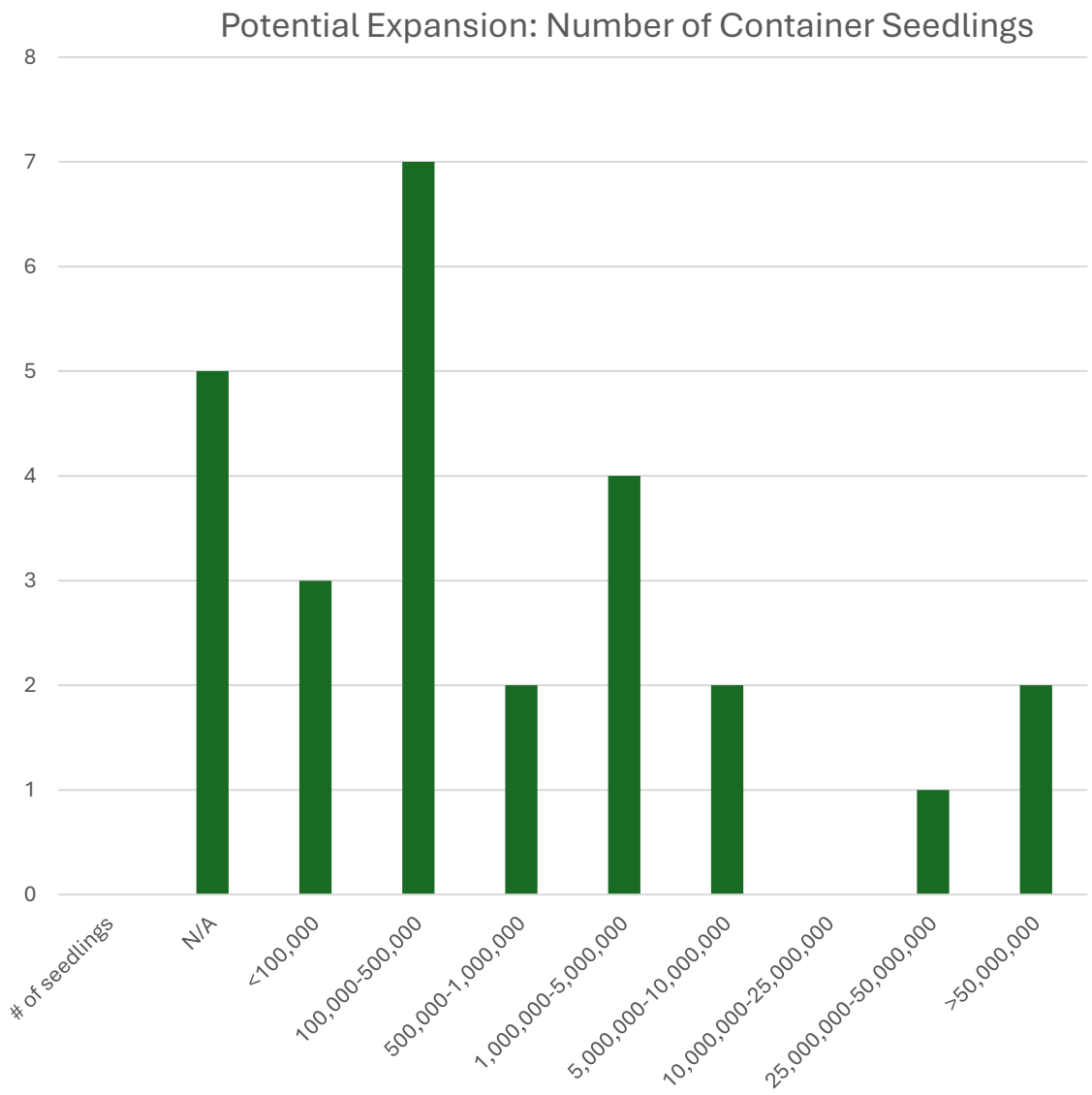

Figure 21. Annual Container Potential Expansion (Seedlings)

Seed Supply and Inventory

Nurseries in the survey utilize a combination of orchard-produced and wild-collected seed to meet their needs (Figure 22).

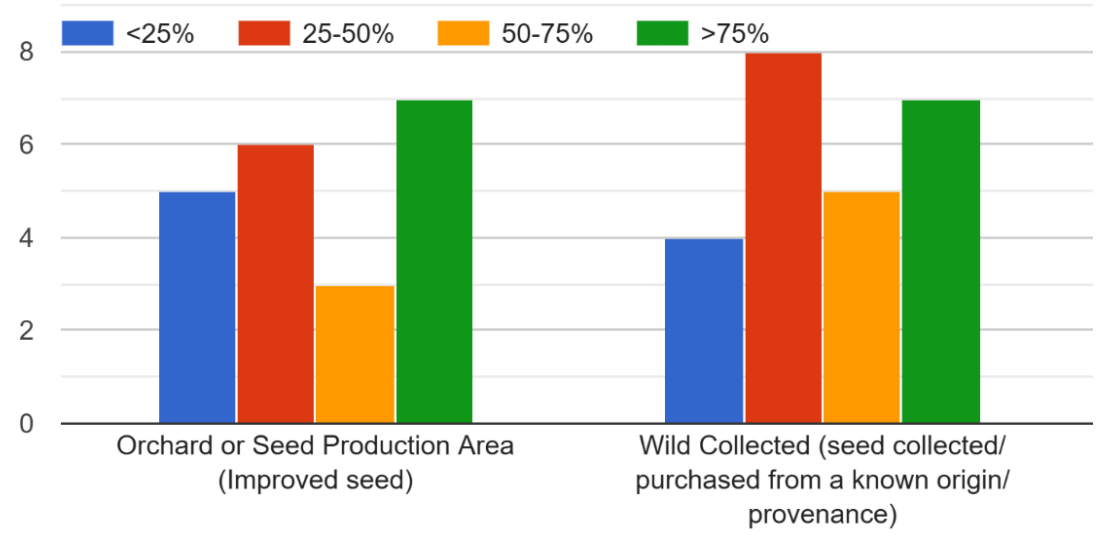

Figure 22. Annual Sources of Seed

Analysis of survey data reveals a large variance in how nurseries source their seeds annually. 29% of respondents reported relying on wild collections for over 75% of their seed, while 33% of respondents also indicated over 75% reliance on seed orchards or seed production areas, with a substantial number falling into the 25-75% reliance range for both wild collections and cultivated sources. For a comprehensive breakdown of each nursery's responses, including a broad overview of species grown and their annual seed sources, please refer to Appendix C.

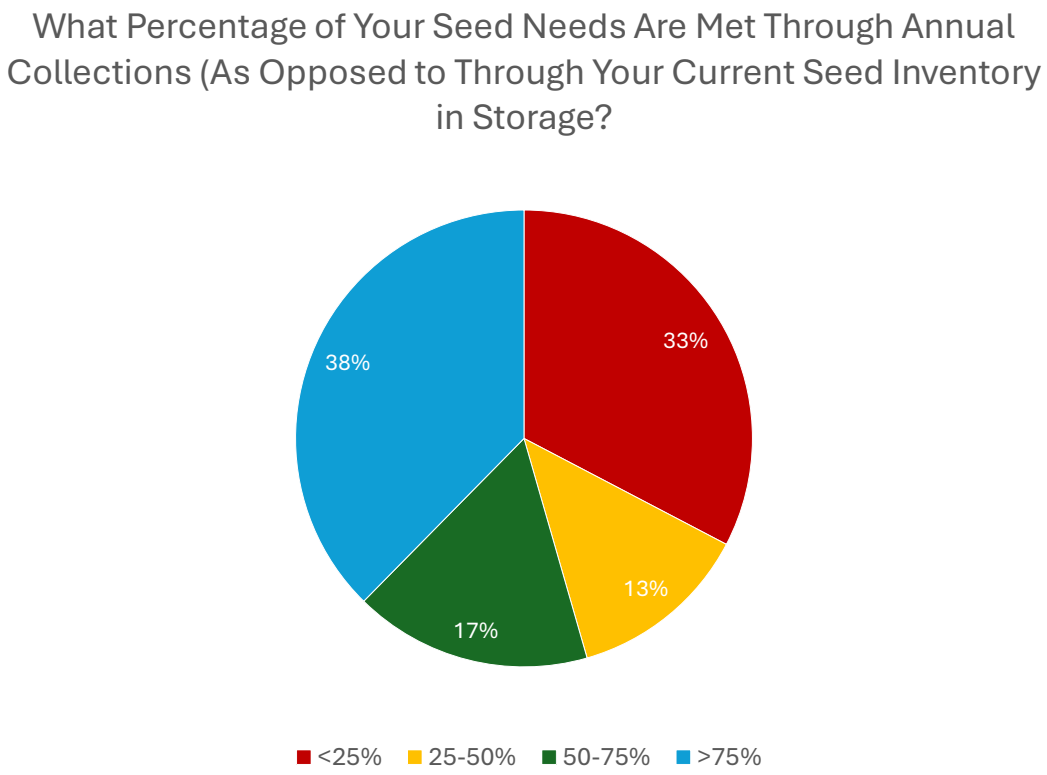

Figure 23. Percentage of seed needs met through annual collections (and not current inventory)

Regarding seed need via collections versus inventory, there also appears to be high variance, with 38% of respondents meeting over 75% of their seed needs through annual collections (rather than inventory), while 33% meet less than 25% of their seed need through annual collections (Figure 23)**Figure 23.** Percentage of seed needs met through annual collections (and not current inventory). This indicates a need for more in-depth follow-up surveys to understand this variance.

In terms of current conifer seed inventory, 36% of respondents indicated having a two-year supply of conifer seed, and 16% had a year's supply. Most responses fell under a 2-year supply or less, with 20% indicating they do not have any conifer seed inventory (N/A) (Figure 24)

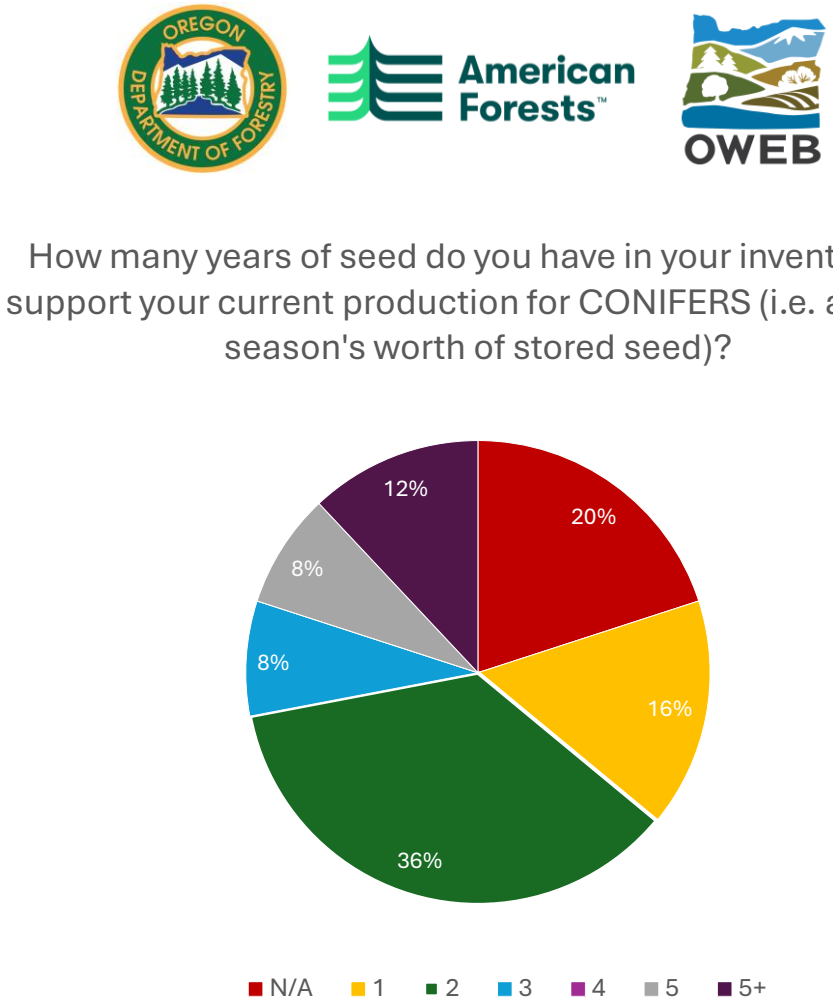

Figure 24. Current Conifer Seed Inventory

In terms of current hardwood seed inventory, 44% maintained a one-year inventory of hardwood seed, and 30% indicated hardwood seed inventory was not applicable. This suggests a generally modest seed inventory, particularly for hardwoods, although most respondents indicated they grow conifers (Figure 25).

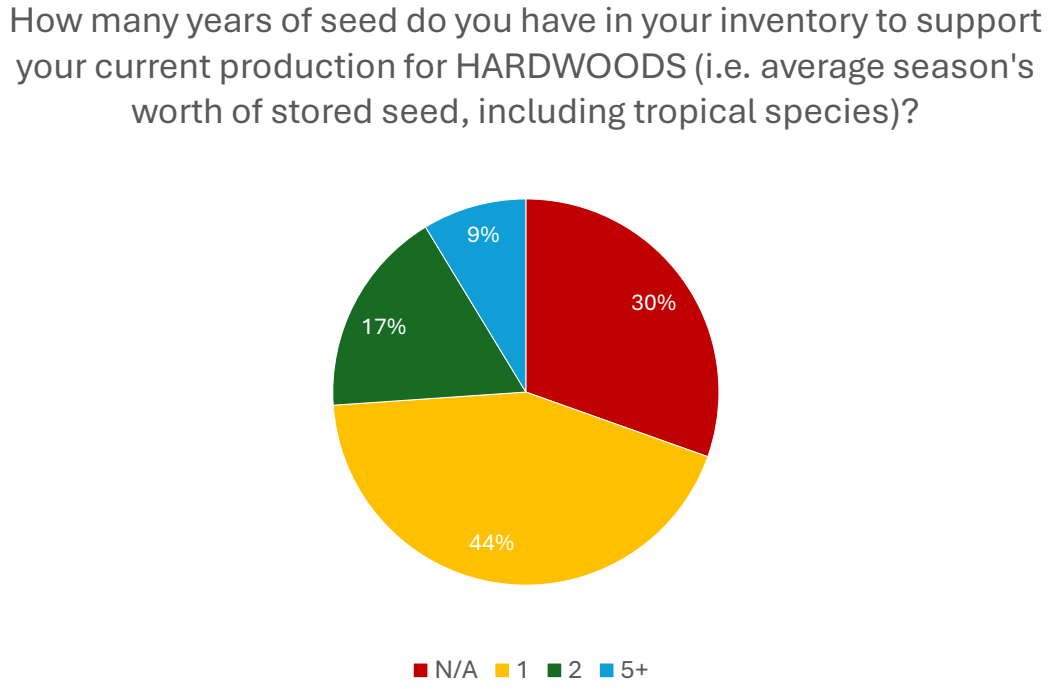

Figure 25. Current Hardwood Seed Inventory

Several additional comments shed light on seed inventory. One respondent noted that "fire restoration planting over the last 10 years has depleted seed inventory," highlighting the impact of wildfires on seed availability and inventory. Another indicated a willingness to "buy and store more conifer seed if more suitable seed was available," pointing to potential limitations in finding appropriate seed sources. Some nurseries "mainly store / supply seed as needed on an ad-hoc basis and do collections based on availability and needs," indicating a more reactive approach, which ties to previous responses on a lack of long-term planning and inconsistent orders year to year.

It was also noted that seed collection and storage are sometimes handled by other departments within organizations, or not at all by respondents. Additionally, 44% do not collect cones, 56% do not perform cone or seed processing, and 50% do not conduct seed testing. This highlights a potential gap in the current capacity assessment, as the capacity, demand, and expansion potential of entities that *do* undertake these activities remain unquantified. It is recommended that future surveys incorporate this component to gain a more comprehensive understanding of overall seed management capacity.

In terms of seedling supply for small woodland owners, order size appears to be a potential constraint. While 54% of respondents indicated they would accept orders of less than 500 seedlings, many have higher minimum order requirements: 23% require a minimum of 500-1,000 seedlings, 15% have a minimum of 1,000-5,000, and 8% have a minimum order size exceeding 10,000 seedlings (Figure 26).

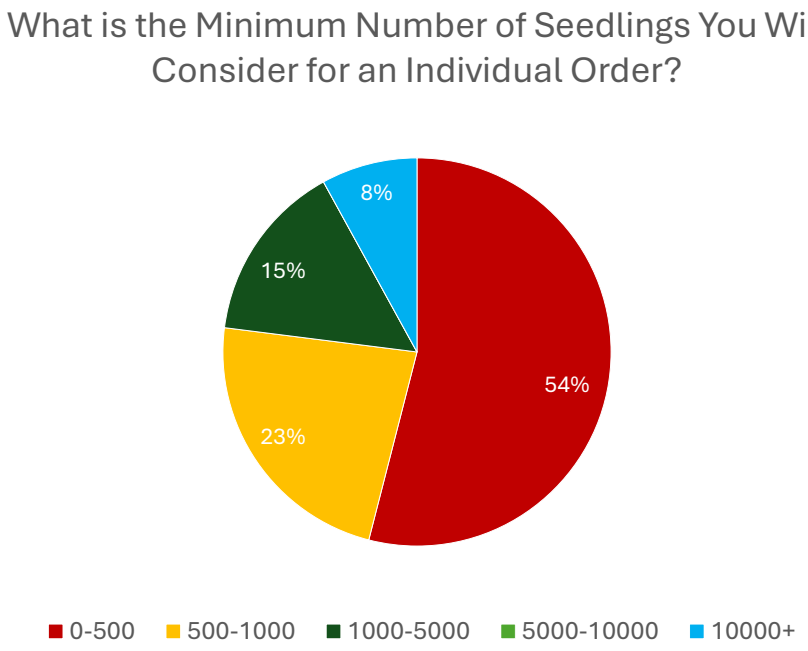

Figure 26. Minimum Seedling Orders Accepted

Conclusion

The nurseries surveyed are largely operating at or near their current desired capacity, particularly in container seedling production. While many possess the *capability* to expand, a lack of consistent increased demand is preventing them from doing so. This cautious approach is a pragmatic business decision, reflecting a preference for operating efficiently relative to existing demand rather than risking underutilized space. Expansion is contingent upon greater certainty in long-term contracts, reduced financial risk, and a demonstrable, consistent increase in demand. The higher utilization of container seedling capacity alongside underutilized bareroot capacity suggests a growing preference for container seedlings and a potential need for nurseries to adjust to accommodate more container seedlings.

Recommendations

Strategic Planning and Long-term Contracts

Strategic planning across reforestation activities can mitigate risks associated with capacity expansion for nurseries, particularly through the establishment of long-term contracts. These multi-year agreements can provide the consistent demand necessary for nurseries to confidently increase their production capacity under a more stable and advanced ordering framework. Developing and actively promoting the adoption of such long-term contracts will provide nurseries with the financial security required to invest in growth. Furthermore, a comprehensive and collaborative strategy that integrates seed collection as a component, advocating for an all-lands approach, is essential to ensure both the quality and quantity of available seed. As climate continues to impact seed viability, having collections across all-lands can better ensure appropriate seed sources for different regions. Exploring the establishment of seed orchards to supplement wild collections should be considered to increase seed availability and viability.

Collaboration and Knowledge Sharing

Building stronger relationships and communication among nurseries, industry partners, non-profit organizations, community stakeholders, and state and federal agencies will facilitate the exchange of best practices, enable collective problem-solving, inform effective reforestation strategies, increase overall reforestation capacity, and support the development of supportive policies. Additionally, by maintaining open and transparent communication across the sectors of the reforestation supply chain, businesses such as nurseries can make more informed decisions regarding stock type and capacity expansion.

Continued Research

We must conduct further research to understand the apparent disconnect between growing reforestation needs and the actual demand for nursery seedlings. Investigating the underlying causes of this gap can lead to the identification of solutions for achieving an increase in reforestation pace and scale. Additionally, to gain a more complete understanding of regional capacity, future surveys need to encompass all entities involved in the various aspects of seed management, such as seed extractories and seed orchards, as well as more detailed surveys of nurseries to understand species specific challenges and capacities.

Establishment of a Reforestation Network

Create a formal partnership, such as California's initiative, to streamline coordination and address critical bottlenecks in the reforestation pipeline. This partnership should focus on:

- Optimizing Seed Supply**:** Increasing cone surveys, developing strategic collection plans, and investing in workforce development for seed collection.

- Developing the Workforce: Establishing programs like the California Cone Corps to train and retain skilled nursery workers.
- Building Partnerships and Collaboration: American Forests is actively working with Washington DNR, Sustainable Northwest, the University of Oregon, Oregon Department of Forestry, OSU Extension, and other organizations to establish a reforestation network in the Pacific Northwest. Data from this project and other relevant sources will be used to inform the priorities and goals of this partnership.
- Strategic Planning and Long-term Contracts

These recommendations are interconnected and require a coordinated effort across the reforestation sector to achieve long-term success in meeting the region's escalating reforestation need. By addressing these recommendations and leveraging existing partnerships, the nursery industry can be better supported to improve its capacity to meet future demand and contribute to successful forest restoration efforts.

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Reforestation Service Provider Capacity, Challenges, and Recommendations for Oregon

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Abstract

Background: The Pacific Northwest faces an escalating reforestation need, driven by intensifying wildfires and ongoing timber harvest. To better address and understand the capacity to meet this growing need, an assessment of reforestation service provider capacity, challenges, and recommendations was conducted through surveys and learning conversations in Oregon and Washington from fall 2024 to spring 2025.

Results: Demand for reforestation services has remained steady or increased, particularly due to wildfires, yet providers face significant constraints. Key challenges identified include unfair pricing and competitive bidding practices that lead to unsustainable margins; workforce instability due to difficulties in retaining seasonal employees and complex reliance on the H-2B temporary worker program; burdensome regulatory and federal bureaucratic hurdles; and critical funding gaps, especially for small woodland owners, compounded by restrictive grant eligibility. Despite these obstacles, providers generally express interest and possess capacity to undertake more reforestation work if these issues are addressed and demand continues to increase.

Conclusion: Recommendations were gathered and synthesized on how to best support the growth and efficiency of the reforestation industry. These include implementing long-term contracts, promoting fair pricing models, increasing and strategically allocating accessible funding, strengthening workforce development, providing targeted support for small woodland owners, developing a comprehensive regional reforestation strategy, and establishing a centralized information hub. Addressing these challenges will foster a more stable, equitable, and effective reforestation sector that is better suited to support the region's ecological health, economic resilience, and long-term sustainability.

Keywords: reforestation, Pacific Northwest, wildfire, forest management, workforce, funding, contracts, Oregon, Washington

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Appendix A. Reforestation Provider Survey

Appendix B. Reforestation Provider Survey Results

Introduction

The intensifying wildfire regime in the Pacific Northwest coupled with timber harvest as a key economic driver in the region necessitates a thorough evaluation of existing and potential reforestation capacity to address the escalating reforestation needs. This report contributes to a broader data assessment quantifying current and projected reforestation needs in Oregon and Washington, which estimates a substantial 817,000 acres within wildfire scars with limited potential for natural regeneration (i.e., >60m from viable seed sources), and 1.275 million acres of post-harvest reforestation need, which equates to a total of 2.092 million acres across Washington and Oregon for estimated current reforestation need. While this report is for Oregon State, it is important to consider this need across state lines as many reforestation providers and nurseries work across state lines and this impacts the overall capacity for reforestation in the Pacific Northwest.

Historically, reforestation efforts focused on regenerating harvested areas, but a decline in timber harvests in the 1970s through 1990s coupled with recent increases in wildfire extent, frequency, and area burned at high-severity, has led to post-fire restoration emerging as a dominant factor influencing reforestation needs in the Western United States (Parks and Abatzoglou, 2020; Haugo et al., 2019; Halofsky et al., 2018; Dumroese et al., 2005) and accounts for a substantial proportion of the demand (e.g., 81% on National Forest System lands ; USDA Forest Service 2022).

Concurrently, reforestation in Oregon remains significantly influenced by regulatory requirements following timber harvest, a key economic sector contributing to employment and wages (Oregon Employment Department, 2025). The Oregon Forest Practices Act mandates reforestation after significant timber removal, establishing a consistent demand, particularly in Western Oregon (Oregon Department of Forestry, 2024).

Addressing the multifaceted drivers of reforestation demand necessitates not only accurate estimations of current and future reforestation needs, but also a comprehensive understanding of the logistical and operational constraints facing the reforestation sector. This report presents findings from research employing surveys and semi-structured learning conversations conducted from fall 2024 to spring 2025. The objective was to deepen the understanding around capacity, challenges, and obstacles encountered by reforestation service providers in Oregon and Washington, and what they see as solutions to better support their reforestation efforts. The study also incorporates insights gleaned from engagement with the Western Oregon Cascades Recovery Effort (WOCRE) group. The overarching objective of this research is to provide insights that can inform the development of evidence-based strategies and policies aimed at supporting the reforestation industry's capacity to effectively address current and projected reforestation demands in the Pacific Northwest.

Table 4. Key Terms

Key Terms	
H-2B Workers (or H-2B)	A temporary non-immigrant visa program that permits U.S. employers to hire foreign workers to come to the United States to perform temporary non-agricultural services or labor on a seasonal basis.
Indefinite Delivery, Indefinite Quantity (IDIQ)	A type of contract allowing for an indefinite quantity of services over a fixed period, with specific work ordered as needed.
Occupational Safety and Health Administration (OSHA)	The U.S. Department of Labor agency responsible for ensuring safe and healthful working conditions by setting and enforcing standards.
Contracting Officer Representative (COR) (for federal contracts)	A federal government employee who is designated and authorized in writing by a Contracting Officer (CO) to perform specific technical or administrative functions in the administration of a federal contract. The COR must be a federal employee for federal contracts.
FPA Mandatory Reforestation	Refers to the legal requirement mandated by the Forest Practices Act (FPA) for landowners to replant areas where trees have been harvested.

Methods

Reforestation service providers were identified through multiple sources, including the Reforestation, Nurseries, and Genetic Resources (RNGR) Directory, the Washington State Department of Labor and Industries, WOCRE, and input from Washington Department of Natural Resources (DNR), Oregon Department of Forestry (ODF), and reforestation providers.

A survey was distributed via email to a list of providers (n=108), and distributed after meetings and through partners, yielding 26 responses. One-on-one conversations were held with 11 providers in Washington and Oregon to yield deeper insights into the survey responses. An interactive meeting was held with the Western Oregon Cascades Recovery Effort (WOCRE) group, with 17 attendees. Data from the surveys, learning conversations, and WOCRE meeting were analyzed to identify key findings and themes.

Results

General Information and Operations

The reforestation survey, drawing responses from 26 individuals primarily working in either or both Washington (15) and Oregon (19), provides insights into the current state of the industry.

The majority of respondents (60%) are affiliated with for-profit organizations, and their primary activities encompass reforestation (92%), thinning (84%), and site preparation (76%) (Figure 1).

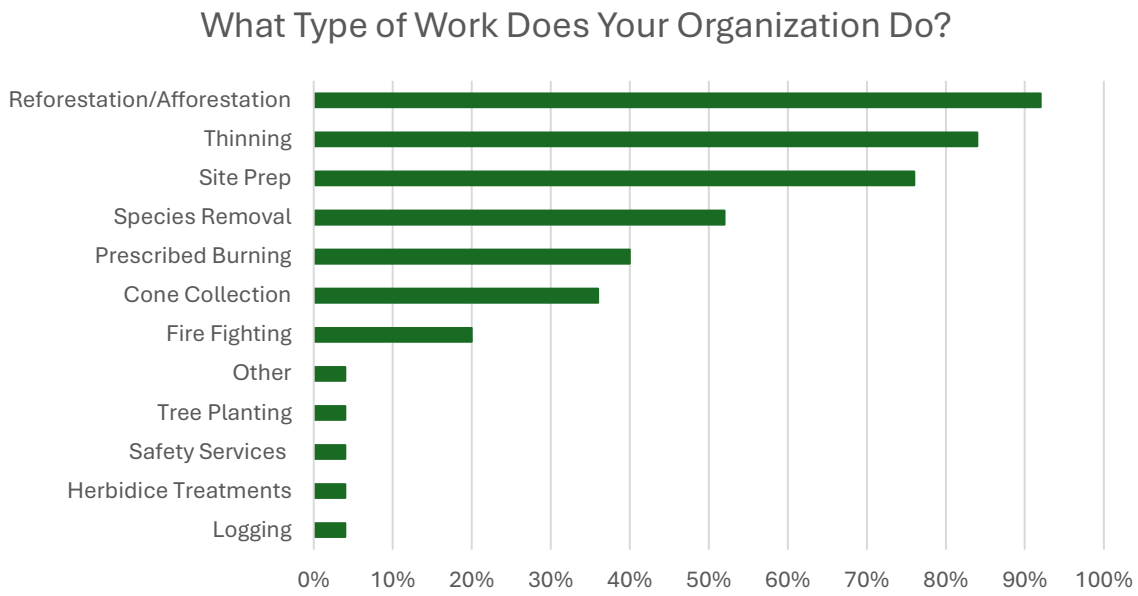

Figure 27. What type of work does your organization do?

When asked what their top three activities that make up their organization's work each year were, "Reforestation/Planting" was cited as the top activity (68%), followed by Hazardous Fuels Reduction and Harvest/Logging (both at 32%). In terms of business scale, most organizations operate with budgets between $1,000,000 and $5,000,000 (58%) and a majority (60%) employ fewer than 25 people annually. The work undertaken spans various land ownership types, including small woodland owners (64%), private industrial lands (60%), state lands (44%), federal lands (36%) and tribal lands (32%). The acquisition of work predominantly occurs through direct contracts (64%), with a quarter of respondents engaging in both direct contracts and subcontracts. Word-of-mouth referrals (36%) and online government platforms (20%) serve as the primary avenues for securing work. The busiest months for reforestation activities are September and October, followed by April, March and August. The least busy month is December, followed by January and June.

Reforestation or active planting efforts are largely between 500-10,000 acres annually among respondents (Figure 2).

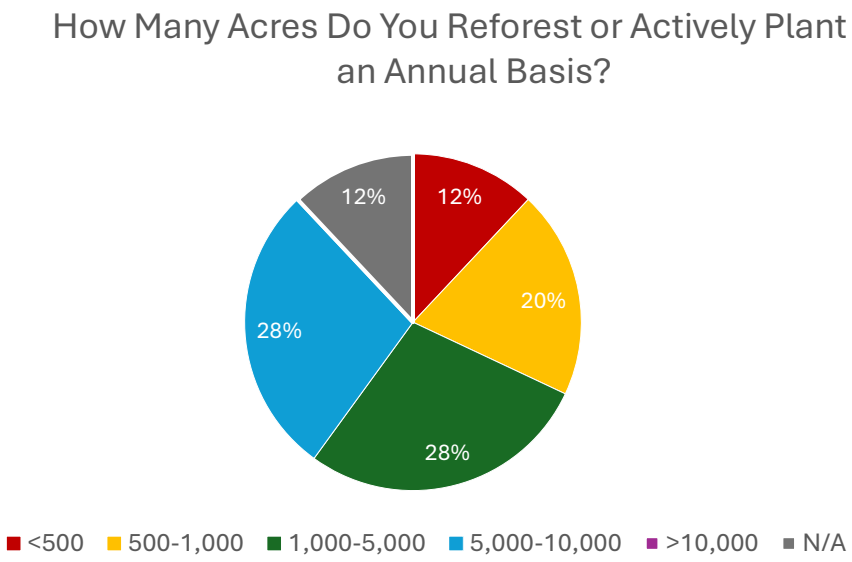

Figure 28. Annual Reforestation or Planting in Acres

The majority of respondents thin less than 500 acres per year (Figure 3), and half of the respondents do not do any prescribed burning (Figure 4).

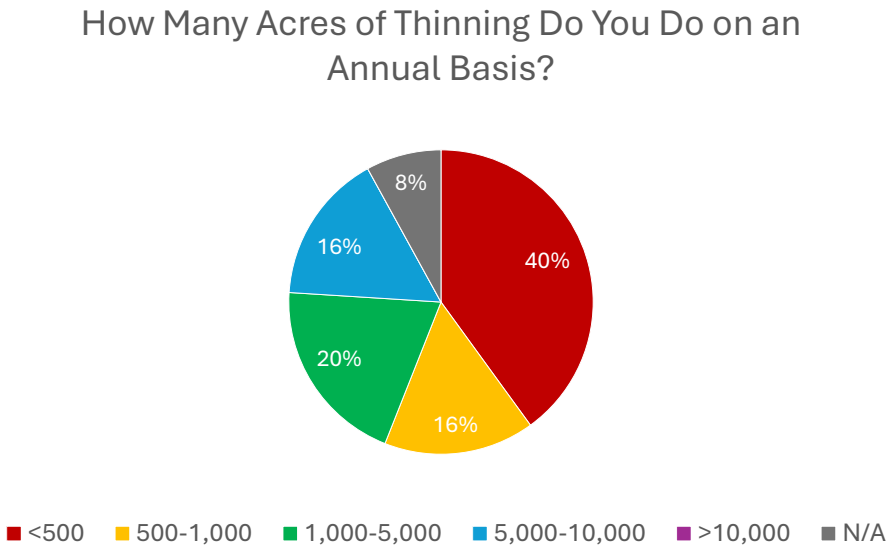

Figure 29. Annual Acres of Thinning

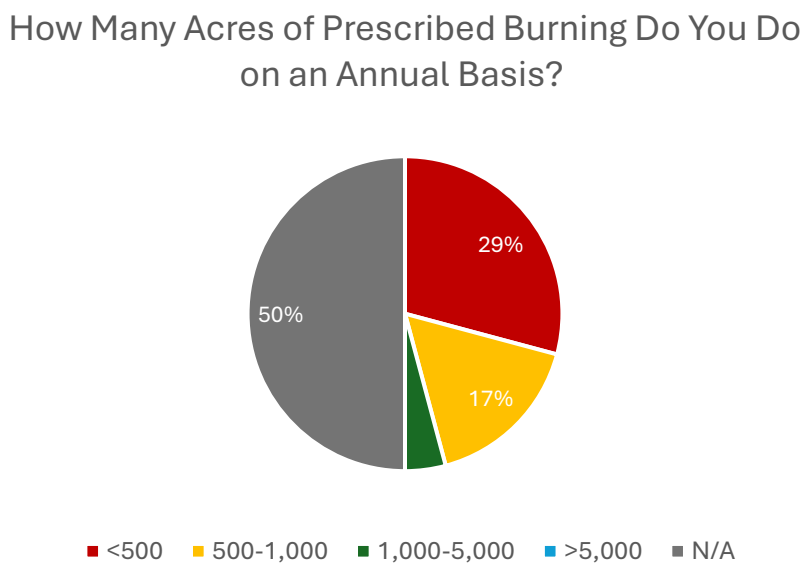

Figure 30. Annual Acres of Prescribed Burning

Reforestation Demand and Need

Based on discussions with reforestation service providers in Oregon and Washington, the demand for their services appears stable or on the rise, with wildfires as an underlying factor. Survey data asking about demand for the last five years corroborates this, indicating that demand has either remained consistent or increased (Figure 5).

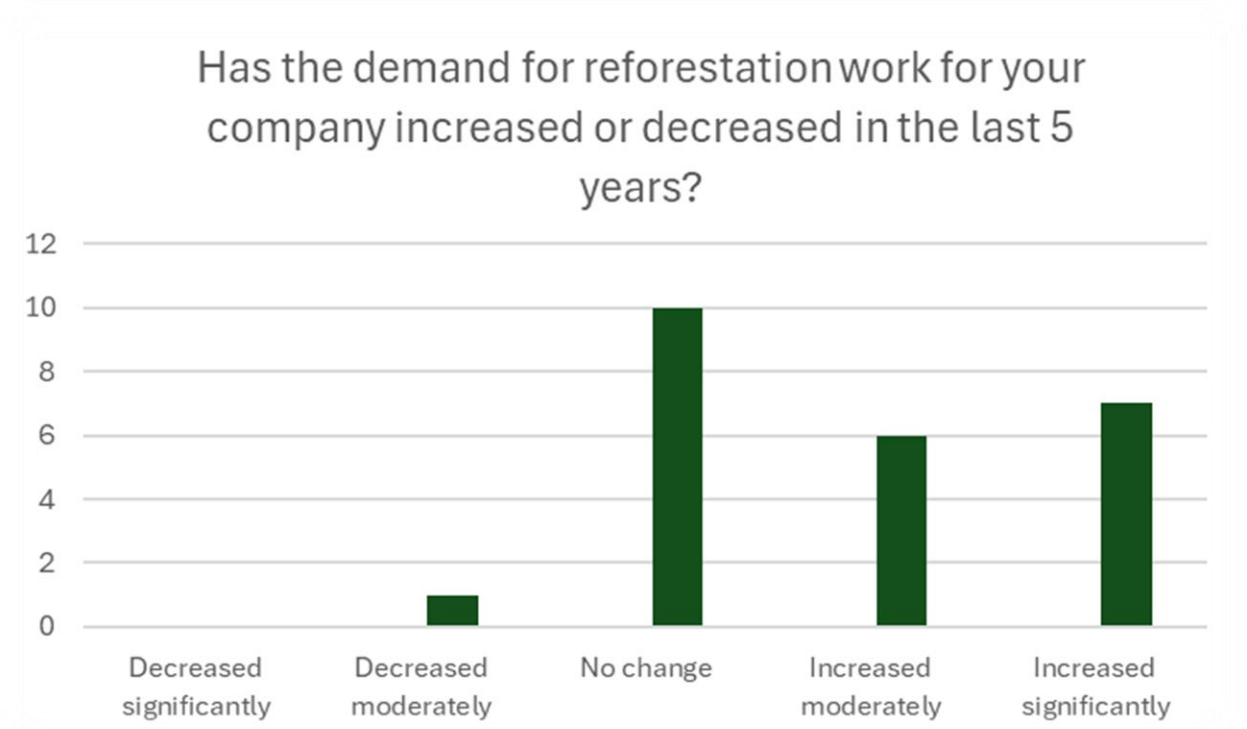

Figure 31. Reforestation Demand

Fluctuations in demand were sometimes linked to the dynamics of the log market and timber harvest schedules. However, a notable driver for increased demand, according to many respondents, is the increasing prevalence of wildfires. One participant clearly stated that "large scale wildfire has significantly increased our need for reforestation." The extensive Labor Day fires of 2020 were frequently mentioned as a key contributor to this heightened demand. Consequently, landowners have also shown a greater interest in active reforestation on their lands, seemingly becoming "more responsible with what needs to be done on their properties" as one individual explained, also noting that they "get better help assistance, that's why they choose to manage their lands more."

A reforestation service provider with extensive experience since 1987, and currently leading a reforestation company, pointed out that this shift in what is driving demand necessitates a reevaluation of traditional practices like "even aged management, grid planting, et cetera." This individual observed that "this is a different era because it is post-fire," emphasizing the need to embrace "natural regeneration that's happening" and advocating for "a more holistic approach for reforestation," essentially a "need to redefine what reforestation is."

Conversations exploring the relationship between reforestation demand and actual need revealed a strong consensus regarding their misalignment. One participant articulated this by stating that

"silviculture is on the expenditure side of forestry, and logging is on the side of the business, if a fire hits an area that hasn't been logged before, the incentive to reforest is relatively low." The influence of cost or available funding on this discrepancy emerged as a recurring theme, exemplified by the comment, "There's way more need than anything. I talk to CORs, foresters all over the United States and they're all saying, if I had the budget, we could do all of this work. There's a lot of need to do it, but funding is a limitation."

One participant offered a perspective on the interplay between demand and need, remarking that "the demand has to catch up with the need," while also emphasizing that "the need needs to also be strategic," suggesting "we need to let nature do a lot of the work, and we need to be there to help."

The challenges associated with scaling reforestation efforts across numerous small woodland owners were also highlighted. As one respondent pointed out, "if someone just had their house burn down it can be harder for them to go through the process of post planting…operations are the easy part. The problem is funding and getting landowners on board. There's a lot of client meetings for people with 20-40 acres for them to understand what's going on."

Reforestation Capacity

Reforestation capacity in Washington and Oregon appears to be largely sufficient for the current demand, as indicated by the strong interest among the majority of respondents in undertaking more reforestation work (Figure 6). Many participants expressed a desire for an increased workload to optimize their schedules and facilitate business growth within the region, however funding for reforestation projects is a limitation. Several also highlighted the importance of reforestation for maintaining healthy forests and bolstering local economies in Washington and Oregon. One respondent stated, "We feel like we need to manage better the lands that need to

be planted to keep the forests healthy and to keep the jobs for many families, so we would like for reforestation to increase more."

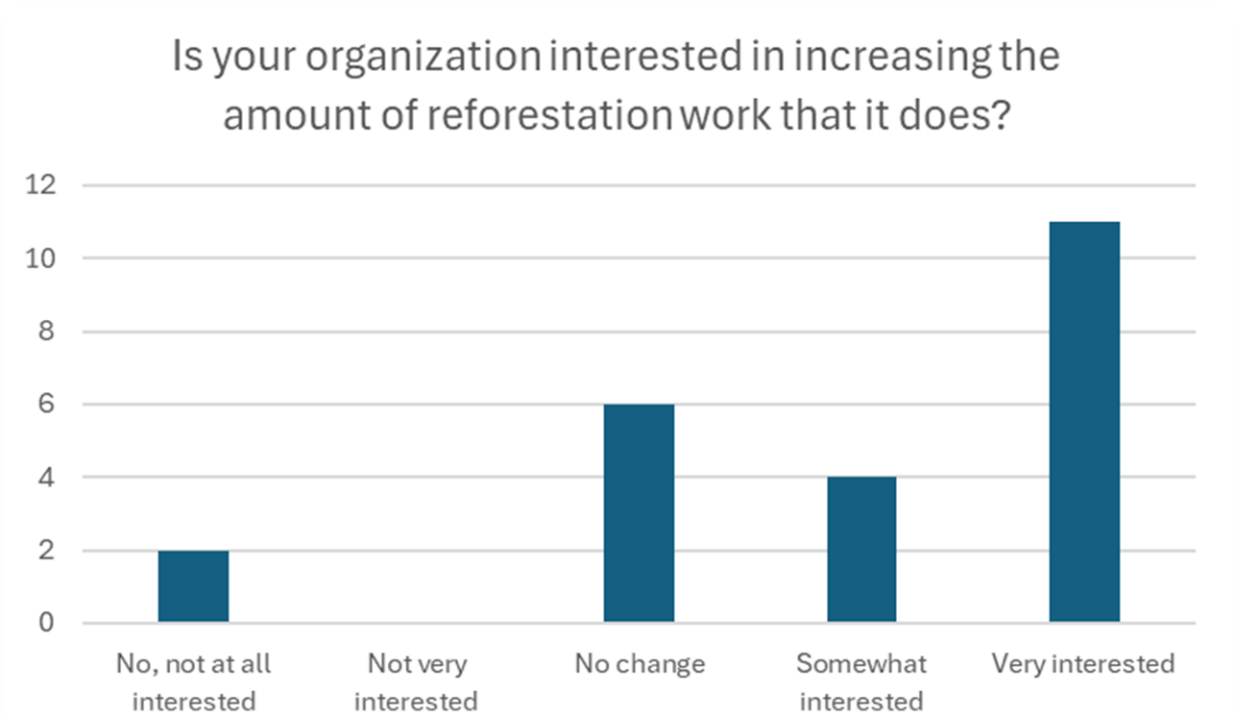

Figure 32. Interest in Increasing Reforestation Work

When specifically questioned about their ability to increase capacity, most indicated it was not a limiting factor. One individual asserted, "Capacity is not an issue. Right now, at this time, [we] could get 5,000 workers in Oregon or Washington immediately," while also noting that these workers "are all dispersed in different states because there is not enough work in Washington and Oregon to keep them here." He added many would prefer to stay local. Another respondent noted, "We have the capacity and the infrastructure to expand. We can handle expansion," while also pointing out, "It's a matter of if it's possible to obtain that many workers and that number can fluctuate all the time" (referring to H-2B workers). Furthermore, the ease of scaling operations if demand were to increase was mentioned, with one participant explaining, "We could definitely scale. If the demand was there...Operations are easy. It's the funding and paperwork that are the challenges."

Challenges to Reforestation Efforts

Despite an increase in demand and a desire to increase reforestation work, the survey and learning conversations identified several challenges, including low bids and insufficient pay,

complex contracts with federal agencies, and regulatory hurdles that impact profitability (Figure 7). Workforce issues, such as the difficulty in finding and retaining experienced seasonal employees and navigating the H-2B worker process, were also prominent concerns. Limited funding for small private landowners post-burn and complicated funding applications pose additional obstacles.

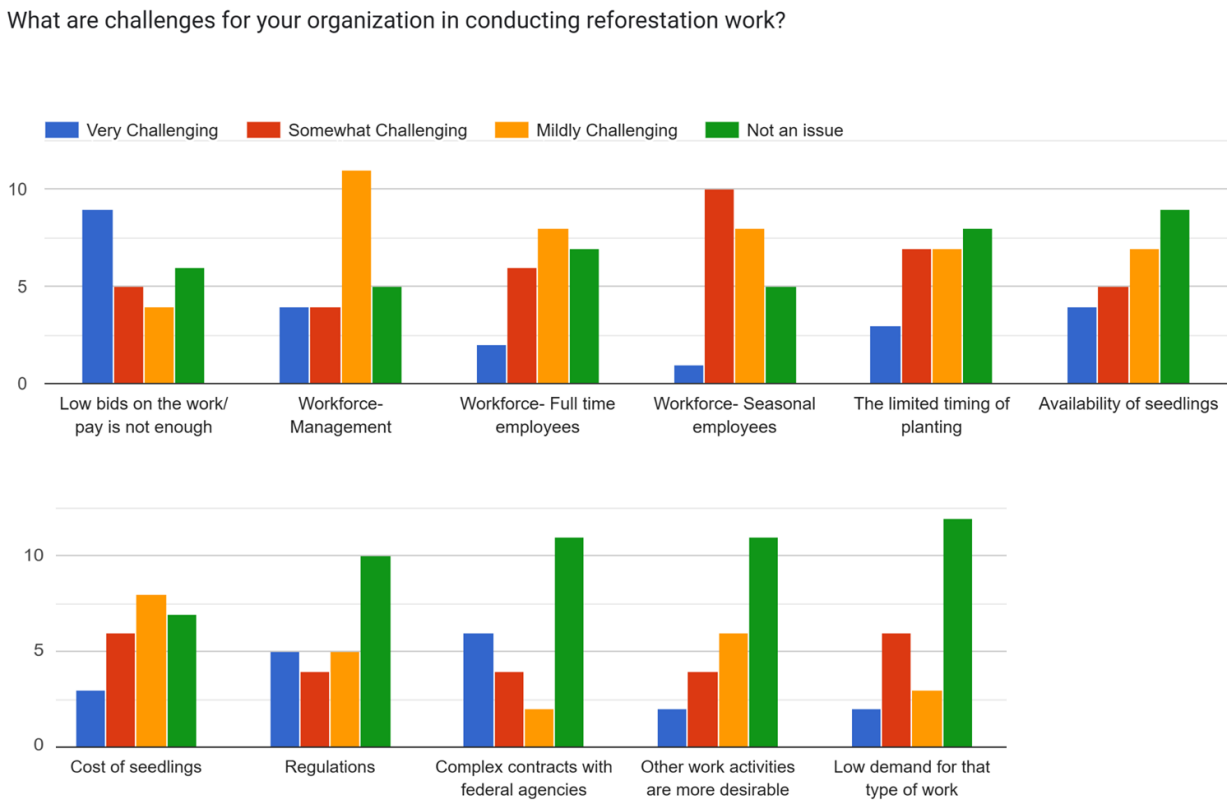

Figure 33. Challenges to Reforestation Work

Low Bids/Unfair Pricing

Low bids and the challenges of unfair pricing emerged as a predominant concern in both the survey responses and subsequent discussions regarding reforestation. One respondent identified "lowball competing bids" as the "biggest challenge," also noting the difficulty in "finding employees who are experienced and able to be seasonal." The bidding process itself was frequently cited as problematic. As one participant explained:

> There is a lot of competition with bidding. {We} are trying to work with new companies, but it makes it harder to bid when {the new} companies place their bids way too low. It makes it hard to actually place a fair bid.

The issue of fair pricing and equitable pay was a recurring theme among reforestation service providers. One provider pointed out, "They are paying so little for the jobs. The lowest bid gets the job." This can create an uneven playing field, as some organizations, the respondent explained, "do firefighting, too. So, they will make all their money firefighting, and then just pick up very low bids to keep their employees busy year-round," making it difficult for companies without this additional revenue stream to compete with those "that do and then come in with the low bids, which larger businesses often can do versus smaller businesses."

Frustration with the bidding process was also evident, with one participant noting the extensive requirements: "Bids require a safety plan, there's like 5 factors: Past Performance Evaluations, Questionnaires…It's a lengthy process." However, the outcome often seems disconnected from these considerations, as the respondent concluded, "but then it doesn't matter, the PPE, all of it, it doesn't matter, they just go with the lowest bid." This approach, as another participant pointed out, occurs because "they have a budget, and if someone goes half price, they will get the work because it's a low bid," even though "you have to look at the quality of the work, the past experience, too, and they don't." This dynamic puts pressure on reforestation organizations to balance offering fair wages with the necessity of submitting competitive bids, a situation highlighted by one participant who stated, "Most contractors know each other. We will talk to each other. Ask how things are going. Many contractors are losing money {on projects}."

One participant also shed light on how regulations can unintentionally contribute to pricing disparities and potential non-compliance. Regarding federal contracts, they explained the requirement to "pay benefits on top of that {minimum} wage," recounting an instance where informing subcontractors that "with the minimum wage and benefits, they would have to pay $30.08 an hour" revealed that "several had no idea they had to pay that much to their {H-2B} workers legally." This suggests a potential lack of awareness or enforcement, leading the participant to conclude, "I guarantee you there are other contractors paying them less because they don't know or don't care about meeting those legal requirements" he went on to say he felt most were unwittingly paying too little "…no one will know they're not paying well enough unless they are audited."

Workforce

Feedback regarding workforce challenges in reforestation pointed to issues of consistency and planning rather than a fundamental lack of available workers. The fluctuating nature of both reforestation and general forestry work, combined with insufficient long-term planning, makes it difficult for contractors to maintain a stable workforce, invest in their operations, and secure dependable projects. The extended and uncertain timeline of the H-2B process, often requiring

12 to 18 months, combined with the unpredictable demands of reforestation, hinders effective workforce planning. As one contractor stated, "If I know I will have the work, I can line out workers no problem. But I need to know in advance because it is a lengthy process, and I have to be able to demonstrate they will have the work."

Furthermore, the annual cycle of the H-2B visa program necessitates recurring expenses for visas, travel, legal consultation, and relocation, and contributes to the loss of trained workers, requiring continuous retraining efforts. "The more they work, the more they learn," one participant noted, "But they work ten months at a time and if they leave and don't come back, then I have to train all over again," highlighting the difficulty in retaining skilled labor. The federally mandated cap on H-2B visas appears inadequate to meet the labor needs of seasonal businesses, often requiring a lottery system if demand exceeds the quota, typically in January for an April 1st start date. This introduces significant unpredictability and uncertainty for businesses trying to reliably forecast their workforce capacity and plan for contracted work. "A huge percentage of the work being done in the West is done with foreign workers," one individual emphasized, stating plainly, "If you don't have foreign workers, you don't have a business. That's it in a nutshell." This reliance is underscored by the difficulty in attracting domestic workers, as evidenced by the statement, "There's not an understanding of how much US businesses and industries rely on the foreign worker programs. The idea we are displacing the US workforce is a fallacy. We advertise in 11 Western states and we get no one applying for our jobs with a pay range of $25-35 per hour." This represents a shift from the past, as one participant recalled, "In the 80s, 80% of the workforce were Americans. Now it's mostly H-2B workers," further suggesting a connection to pay, noting, "It was better pay then, for everyone. They could negotiate for enough money to pay everyone. Now, it's mostly H-2B workers because they have to hire people from poorer areas that want the work for less pay."

This dependence on the H-2B program raises questions about the long-term sustainability of the reforestation workforce. Given this reliance, any disruptions or changes to the visa program could substantially impact the availability of labor for reforestation efforts. This begs the question of sustainability: what would happen to the reforestation workforce if this program were significantly altered or eliminated? Furthermore, the ethical implications of such a dependence on a temporary foreign workforce also warrant consideration, alongside the need to understand why domestic workers are not interested in this type of work or how to better incentivize it for them. The inadequacy of the federal cap on H-2B workers and the resulting lottery system further exacerbate the unpredictability and uncertainty for businesses attempting to expand their workforce to meet reforestation needs.

Regulatory and Administrative

The reforestation sector in Washington and Oregon faces considerable regulatory and administrative burdens that affect both how efficiently they can operate and their financial stability. A primary challenge stems from complying with labor regulations, especially those enforced by

the Department of Labor (DOL). This is highlighted by the concern that "many contractors do not have a concept of what it takes to stay in compliance and be prepared for audits." For some, interactions with the DOL feel more punitive than supportive; as one individual described, "The Department of Labor just comes in and runs them over," rather than trying to "educate, help them, get them compliant," they simply "come in and {heavily} fine the {business}." This is particularly challenging for many independent contractors and newer businesses who reportedly lack the expertise to navigate complex requirements around insurance, payroll, and foreign worker programs, increasing their risk. This lack of knowledge around basic requirements, like adhering to minimum wage, leaves them vulnerable to costly DOL scrutiny, where "audits will never be painless," and it's expensive "just to get ready for audits," with the likelihood that "every time they will still find something, and it will be a few thousand dollars." This vulnerability contributes to the sentiment that "most will not be in business in 5 years due to undercapitalization or DOL or USCIS (U.S. Citizenship and Immigration Services) audits."

Beyond DOL regulations, the increasing cost of OSHA fines for even minor infractions poses another challenge. Furthermore, the relevance of some OSHA regulations to the specific work of reforestation is questioned, with concerns that "OSHA regulations don't make sense" because "they require training, but the training is geared toward loggers, not replanting or site prep," focusing on "safety that's unrelated to the work." This disconnect underscores a broader need to revisit and redefine reforestation practices, as some existing regulatory requirements may no longer be applicable or appropriate for the realities of current reforestation efforts, particularly in the context of post-fire restoration.

Federal

Many federal obstacles and challenges are included in the above paragraphs, such as regulatory hurdles, complex contracts, the H-2B process, and low bids being prioritized over the quality of work. Reforestation efforts on federal lands face a unique set of challenges. The complexities of federal contracting are an impediment, with convoluted processes leading to missed opportunities, as evidenced by instances where contractors "sometimes have not gotten an IDIQ contract because of a small oversight." Furthermore, the availability of Contracting Officer Representatives (CORs) can severely impact projects, with instances reported where projects were "ready to go on federal contracts and then a COR can't be found and the whole project is off." The prioritization of low bids often overshadows the quality of work, and agencies are perceived as "so cheap. {They} just go with the lowest bids." There are also concerns that work on federal lands is more dangerous work because "{Federal lands are} not as safe to work on as private industrial. Snags can be left for years, which creates a safety hazard for crews. Private will clear after fire, so it's safe, and they plant bigger trees {2 years old}, so they have better survival rates." These paradigms lead some to feel the "work isn't worth it" and that they "don't make much more than you would at McDonalds." There is a reluctance to engage with federal agencies on federal projects, as evidenced by the comment "There is a desire to work with others than federal

agencies on federal lands…If there are more opportunities, a private agency would be better to work with." Another noted that, "it would be preferable to work with private or nonprofit organizations representing federal agencies." The inherent bureaucracy within federal agencies can also cause significant delays, with reports of how "Federal bureaucracy can slow down or stall projects." The unreliability of government funding, exemplified by instances where federal hiring freezes have halted work that is dependent on proper timing, further complicates reforestation efforts on these lands.

Small Woodland Owners

Reforestation efforts on non-industrial private forest lands face other challenges. One of which is the fundamental issue of seedling availability. As one respondent noted, even when attempting to source seedlings from a state nursery, they are "short on the seedlings, they are unable to fulfill the entirety of the order." This necessitates time-consuming searches for alternative suppliers. Many noted the difficulty getting smaller orders filled at nurseries. The escalating "cost of planting" further exacerbates the situation, particularly for landowners undertaking reforestation projects. While "robust funding through USDA and WA DNR" exists, respondents remarked that the demand far exceeds the supply, resulting in many applicants denied or facing significant out-of-pocket expenses, often a 50% cost share that many small woodland owners "don't have the capacity to pay." There is also a general "lack of understanding of how to go about doing {reforestation}." Participants noted that many landowners lack forestry experience and may not even realize the need to replant degraded lands or be aware of available resources. One participant highlighted that "labor is not an issue so much as people don't know how to find them, how to contract with them, how to design a planting project that meets their objectives," underscoring the need for better support in project implementation.

Funding remains a fundamental obstacle hindering widespread reforestation efforts for small woodland owners. The current system can counterintuitively penalize proactive forest management, as landowners who undertake salvage logging after events like wildfires may become ineligible for reforestation funding. As one source pointed out, it would be "a huge help" if "the DNR grants could get away from the salvage logging restriction." This is particularly perplexing considering that landowners are often advised to conduct salvage logging because "it's good forestry, it gets it cleaned up, it's safety." However, current legislative guidance dictates that "if it's under FPA mandatory reforestation then they can't get funding," because salvage logging is considered harvest. These requirements "need to be relooked at and more nuanced." Participants consistently highlighted the necessity for more streamlined funding mechanisms and targeted outreach to effectively engage and support small woodland owners in undertaking reforestation.

Navigating the complexities of various funding sources further complicates the process, including federal programs like the NRCS with their associated "hurdles and paperwork," and state-level initiatives with their specific eligibility criteria. The financial burden on individual landowners is

significant, as one respondent noted, "Small private landowners can't spend $50,000 to replant a forest if they didn't make any money salvage logging." Furthermore, the sheer scale of landowner engagement required for extensive reforestation across numerous smaller properties adds to the financial strain and administrative burden. As one individual explained, while managing "a million acres on one landowner's land...is no big deal," dealing with "a million acres on multiple landowners, that's a lot of meetings and handholding." The "unreliability of government funding and even temporary freezes" further exacerbate these challenges, hindering the ability of organizations to implement reforestation work for small private landowners. In February of 2025, multiple federal funding sources for reforestation efforts were frozen, causing a delay or even preventing reforestation projects from occurring. While many of these were temporary freezes, there is a small window to conduct reforestation and planting efforts, and typically that window only occurs in the Fall and Spring. Even a two-month freeze of funds can have significant impacts on the ability to reforest. In the end, as one expert succinctly summarized, "The big issue is funding. Where's the money coming from. It's expensive to do this work."

Recommendations for Reforestation Efforts

Based on the information gathered from reforestation service providers in the Pacific Northwest, several recommendations emerged to better support reforestation efforts. These include long-term contracts, fair pricing and streamlined processes, increased and strategic funding, the development of a comprehensive reforestation strategy, workforce development and capacity building, fostering collaborations, and providing support for small woodland owners, alongside the need for adaptive reforestation and a centralized information hub.

Long-term Contracts

The need for long-term contracts to foster stability and growth within the industry is a common theme mentioned in the survey, meetings, and conversations. The current system of more short-term agreements makes it difficult for businesses to invest in their infrastructure, workforce development, and long-term planning. As one participant stated, "It's tough to run a business in reforestation because it's so unpredictable." The lack of consistent work prevents companies from securing reliable labor, and the time-consuming and expensive H-2B annual visa process further exacerbates uncertainties with a seasonal workforce. Providers emphasized that "if they KNOW they will have the work then they can invest in their companies" and achieve "consistency and continuity" in their workforce. Transitioning from short-term contracts to longer-term agreements (e.g., 3-5 years) would provide contractors with the stability needed to make strategic investments, project planning, retain skilled workers for multiple planting seasons, and ultimately have more effective reforestation outcomes. As another provider noted, "with long-term contracts we can plan for and keep workers on year-round."

Simplifying and extending visa durations to accommodate longer term projects would also reduce administrative costs and improve workforce retention. One contractor suggested:

> *"If they could do something like a 3 year visa or longer term H-2B contracts where they could see their family in the winter but know they have work to come back to in the spring, then I wouldn't have to retrain or pay a lawyer to go through the H-2B process all over again."*

Long-term commitments can also help with issues with seed sourcing and survival, as one forester now working in the nursery field noted, "Several buyers don't have long term contracts; they just order the extra ones produced from a pool of seedlings. Then they don't survive as well because it's not the right climate." Long-term contracts also help to support partnerships between landowners, government agencies, tree nurseries, and reforestation contractors. "Long term commitments and agreements are needed to create long term relationships." This can foster trust and ensure a more reliable supply and demand of services, reducing risk to those involved.

Fair Pricing and Streamlined Processes

A significant concern revolves around fair pricing, bidding processes, and the need for more streamlined administrative procedures. Many providers emphasized the necessity of aligning pay with the work involved, noting that "we should look into what's actually fair pricing to pay for something." To address disparities in bids and pay, providers suggest "simple contracts where specifications are clear, easier to negotiate price" and "fair pricing. Pay has to match the work," to better ensure outcomes that are "good for the contractor and the land." The current bidding process is described as creating "tension, super low pay." One provider emphasized the importance of proactive communication and collaboration, stating, "We need to include reforestation guys in the planning process, so they know it's coming up. If they know the work will be here, there will be less tension on contracting and bidding." The lack of adequate quality control is also an issue noted, with one participant stating, "There are no checks and balances for who is doing good work versus who isn't." Many suggest the need for a "best value vs low bid" approach, emphasizing the need to "spend real time vetting contractors prior to award." Some suggested a shift towards "pay per hour instead of IDIQs" and "private contracts instead of federal; work with private or nonprofits representing federal" to improve fairness and efficiency.

Increased and Strategic Funding

Securing dedicated and long-term funding is another common theme mentioned for successful reforestation. Ultimately, as one expert emphasized, "Grant funding is just required. You can't squeeze blood out of a stone and tell people to plant," especially given that "a lot are elderly {or vulnerable}, so they don't have the money to do it." The financial strain on private landowners post-burn is a significant barrier, with one stating:

> Helping private landowners obtain funds for the reforestation work after a burn is the single biggest challenge and barrier to reforestation work getting completed. Burns usually have a negative balance sheet impact to private landowners and reforestation expenses become low on the list of priorities after, say, rebuilding a home.

One suggestion is "a simple reforestation fund with fixed cost share $/acre rates for site prep, spray, and tree planting for burn reforestation" to streamline and simplify the process.

Comprehensive Reforestation Strategy

An overwhelming consensus points to the need for, “an actual state-wide strategy for responding to catastrophic wildfire events and deploying resources for reforestation.” According to participants the strategy should encompass various elements, including:

- Local and state changes to forest type designations
- Tax incentives
- Research on forest transition
- Carbon sequestration considerations
- Workforce development efforts
- Nurseries that will serve small woodland owners
- Establishment of seed and seedling networks
- Prioritization of coordination and partnerships

Such a strategy can ensure a cohesive and effective approach to reforestation in the face of increasing wildfire events. As one participant stressed, "there needs to be a strategy. A plan. Start to finish. That includes planting the trees…I need to have consistency and commitment for the work in advance." Another emphasized the need for a strategy to prioritize where to focus efforts, “the need comes back to influence of reforestation planning and objectives of federal and state partners. We have a lot of work in redefining reforestation in the new climate. How do we prioritize where we put our investment? That’s key.”

Business Development and Capacity Building

Investing in business development and building capacity within the reforestation sector is another key consideration. This includes the need for training in areas such as "management and leadership" and "best practice for prep work," alongside the provision of more supportive tools. However, the realities of "often 70-80 hours a week and for low wages" raise questions about the practicality and accessibility of such development opportunities. Safety training is also a concern, with one comment highlighting that "injuries are blamed on reforestation but there’s not as many resources for training and safety for reforestation." Suggestions to improve workforce development include creating programs offered in both English and Spanish to be more inclusive. Recognizing the administrative burdens faced by many independent contractors, the idea of a "Small Business Development Center for Contractors" was proposed to provide support with essential functions like "insurance, payroll, accounting, how to make spreadsheets." As one participant pointed out, "A lot of these are independent contractors, they don’t have administrative skills… And they end up getting fined for mistakes." Another noted the potential for such support to also address the issue of unfair bidding prices, explaining that "if they received help with {legal requirements}, it would bring the price to a more level playing field because they’d be paying what

they are supposed to." This could help ensure "everyone is playing on the same rules," as the current situation suggests that "most aren't. In fact, none are. It's not intentional. It's just not knowing any better," especially given that "for most, English is a second language" and "the myriad of regulations is off the chart," a complexity even those with dedicated staff struggle to keep up on.

Collaborations and Partnerships

Strengthening collaborations and partnerships across different stakeholders is integral for overcoming the challenges in reforestation. This includes bridging perceived divides, as one participant noted:

> Some people don't want to work {with loggers} because they think they just want to cut down the trees. But that's not true. Loggers love the forest. They are more environmentally aware. There is a disconnect between conservatives and liberals but really everyone needs to come together.

There is a need to recognize and acknowledge that "there are right ways and wrong ways to manage the forests, we need to all work together to learn and streamline the process to have healthier, resilient forests." Participants advocate for bringing people together and innovating local partnerships into broader collaboratives, especially in the context of increasing post-fire recovery needs. As one provider stated, "It has become more and more clear that the only way to be successful is partnerships."

Support for Small Woodland Owners

Providing targeted support and resources for small woodland owners (SWOs) is recommended for expanding reforestation efforts across private lands. This includes developing "more educational materials" and a "guidebook for small woodland owners that would help them know how to plant, what to plant, why to plant so they understand the importance of it and connects them to the resources out there." The guidebook should provide information on where to obtain seedlings, how to find consulting foresters and tree planting companies, and available financial resources. Participants also suggest "approaching property owners with incentives to replant/reforest" through "targeted outreach." The financial constraints faced by SWOs post-burn are a significant challenge, as one provider highlighted: "Small private landowners generally have limited or no funds available for reforestation post-burn; the burn already puts them in a financial hole."

Adaptive Reforestation

The need to adapt reforestation strategies to changing environmental conditions and specific site requirements was also emphasized. This includes considering "replanting strategies for different conditions and locations" and ensuring the "right tree in the right location." The concept of "assisted migration" was mentioned, along with the need for "education on the strategy" and

"resources on how to find the seed stock that meets that criteria." Participants also stressed the importance of not only planting but also ensuring maintenance to prevent project failure due to competing vegetation. Identifying priority areas for reforestation based on factors like natural regeneration, riparian zones and high productivity soils was also suggested.

Centralized Information Hub

Finally, the creation of a centralized information hub or platform was brought up by numerous participants. This idea was also proposed at the 2025 Reforestation Summit to improve communication and access to resources. This platform would combine the multi-decadal knowledge and experience of American Forests with the innovative and community-driven Planscape platform. Initial buy-in and community development by user working groups is necessary to make an information hub or platform like this a success. A suggestion for the hub is to include a way to connect landowners with relevant available surplus seedlings. The idea of a website where contractors could find opportunities with nonprofits and other organizations (and vice versa) was also put forth. “A website where they could find contracts with nonprofits or others might be good, too. There are other reforesters out there working with organizations I didn’t even know existed. A centralized platform to find projects could help.” As one participant put it "communication among nurseries and reforesters, everyone is key." However, funding and developing a platform to account for these gaps in the reforestation pipeline has been difficult to produce. This would require dedicated funding to maintain the longevity and accuracy of the platform.

In alignment with the USFS Forest Landowner Support grant awarded to American Forests and a suite of state, private, and Tribal partners, American Forests is developing a landowner-centric resource hub that supports landowners in understanding reforestation (primarily post-fire) resources, options, and considerations; educates landowners about emerging market opportunities (carbon, water, biodiversity), and will ultimately help connect landowners with technical service providers to develop and implement reforestation plans. There are opportunities to build additional landowner support services into this nascent platform once it is implemented (estimated launch January 2026).

Conclusion

Overall, the key findings of this research indicate a strong demand for reforestation services, yet providers face numerous challenges. Low bids and unfair pricing stand out as major concerns impacting profitability and fair wages. Workforce sustainability and complex contracts, especially with federal agencies, present substantial obstacles. The lack of long-term planning and inconsistent work availability add to these difficulties. Funding for small woodland owners to be able to reforest on their land is a large barrier. Despite these challenges, there is a desire to increase work in reforestation. Improved collaboration, streamlined processes, and increased funding are needed to better support the reforestation industry. The research strongly suggests

the need for a statewide, long-term reforestation strategy to effectively address these challenges and ensure successful reforestation efforts. This strategy should:

- Leverage data and insights from this project to inform long-term planning and decision-making that can result in higher levels of consistency and commitment for reforestation projects.
- Prioritize building partnerships and collaborative efforts to gain stakeholder input, increase capacity, improve communications, streamline processes, build needed networks, and ensure the strategy's effectiveness.
- Explore funding mechanisms to streamline processes and incentivize reforestation efforts.
- Consider policy reforms to support the reforestation workforce, such as modifying the H-2B visa program to allow for long-term commitments to specific projects.
- Promote fair contracting practices that reward quality work and sustainable business models.

American Forests is actively working with Washington DNR, Sustainable Northwest, the University of Oregon, Oregon Department of Forestry, OSU Extension, and other organizations to establish a reforestation network in the Pacific Northwest. Data from this project and other relevant sources will be used to inform the priorities and goals of this partnership. Addressing the challenges identified in this report will support a more effective and sustainable reforestation industry in Oregon and Washington. These efforts could be adapted to other regions across North America and be a model example of how reforestation partnerships and action can be successfully managed. By implementing the recommendations outlined above, it is possible to support reforestation efforts, promote economic growth, and enhance the environmental and community resilience of the region.

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Overarching Conclusion

Oregon faces an escalating need for reforestation across its landscape, driven by ongoing timber harvest and the intensifying impacts of wildfire. This comprehensive assessment identified a substantial current reforestation need from both harvest (499,608 acres from 2015-2023) and wildfire (609,795 acres from 2014-2023). The potential future need is projected to dramatically increase through mid-century, with wildfire-driven reforestation needs expected to rise by 539% in Western Oregon, 532% in Southwestern Oregon, and 442% in Eastern Oregon by the 2060-2069 time period. Addressing these multifaceted challenges demands a unified, proactive, and adaptive management approach that recognizes the interconnectedness of the entire forest restoration ecosystem.

Key Recommendations and Next Steps

Our findings underscore several recommendations that can greatly enhance Oregon's reforestation efforts. First, developing a holistic, adaptive, and strategic reforestation plan is strongly recommended. This plan should account for different drivers of reforestation need across the state, focusing on fire-resilient forest management and post-fire reforestation strategies for Eastern Oregon, while continuing to support timber harvest and reforestation in Western Oregon. It is crucial that the overall strategy emphasizes climate adaptation, including investments in wildfire mitigation and adaptation strategies, and promoting genetically appropriate, climate-adapted seed. This adaptive reforestation approach should tailor strategies to specific site requirements and projected hydroclimatic conditions, allowing joint management lessons and collaborations to inform and adjust approaches. An all-lands approach, encompassing federal, state, Tribal, and private ownerships, is strongly recommended, prioritizing building trusted partnerships to maximize impact and efficiency.

Investing in dedicated seed orchards is strongly recommended to ensure a sustainable seed supply for reforestation, particularly for species most vulnerable to both wildfire and climate stressors. While existing orchards may meet some regional needs for species like Douglas-fir, new orchards are needed for the other tree species that will be further at risk. These are recommended to be tiered toward dominant and codominant species in Eastern Oregon, with a focus on ponderosa pine, to provide genetic diversity for replanting efforts and to create a stored seed supply as a hedge against unpredictable future losses from wildfires, pests, disease, and drought. While ponderosa pine would be the predominate species grown for newly developed orchards, the projected increase in seed need for other species like Pacific silver fir and western hemlock in Western Oregon are missing from established seed orchards and need to be accounted for as seed orchards plan for future need. It is recommended that these new orchards be structured to serve the needs of a variety of landscapes and landowners, including the U.S. Forest Service, Oregon Department of Forestry, private industry, and small woodland owners. Relying on unpredictable natural seed crops is unsustainable, given the variability of

cone crops and the increasing frequency of wildfires. Wildfire can destroy seed sources and disrupt collection efforts during the short collection window, often pulling personnel away to fight fires. With the large projected increase in wildfire reforestation needs, establishing these orchards now will reduce dependence on inconsistent wild collections and provide a reliable, efficient source of high-quality seed to meet future demands. For wild collections, a comprehensive seed strategy should be developed that primarily focuses on collecting adaptive and diverse seed from areas with strong genetics to increase resiliency to pathogenic infections, drought, and heat events.

Strengthening the reforestation supply chain through strategic investments and policy reforms is strongly recommended. This involves transitioning from short-term to long-term (e.g., 3-5 year plus) contracts for nurseries and service providers, providing the necessary financial security and consistent demand for infrastructure investment, workforce development, and operational stability. Implementing fair pricing models that reflect the true cost and value of reforestation work, with a focus on best value over lowest bid, will better support reforestation efforts with higher quality end results. Optimizing nursery and seed capacity requires collaboration with private nurseries and seed banks to ensure an adequate supply of diverse, climate-informed seed-sourcing to align nursery capacity with projected reforestation needs. Significant investment in workforce development and support is also needed, encompassing training in management, leadership, and safety best practices. Addressing the administrative burdens faced by independent contractors by supporting them through Small Business Development Centers will directly boost the success of reforestation companies. Concurrently, reforming the H-2B visa program for longer-term commitments will ensure a stable and skilled labor force for both planting and site preparation, de-risking business expansion.

Enhancing data, monitoring, and information accessibility will drive more effective decision-making. This includes implementing a comprehensive system for tracking harvest data, post-fire regeneration, and planting survivorship across all land ownerships to provide more accurate estimates of reforestation needs and success. Regular monitoring of planting success will allow for adaptive management, providing timely insights into the utility of specific plans. The establishment of a readily accessible, centralized information hub (e.g., a web platform) for all stakeholders is a need that has been expressed across the spectrum of professionals involved in reforestation (see Truettner et al., 2025 in *Reforesta*). This hub should combine multi-decadal and cross-sectional knowledge that connects landowners with resources, surplus seedlings, and service providers. In addition, it could provide educational materials for small woodland owners and serve as a platform for communication among nurseries, reforesters, and other organizations. Leveraging existing initiatives, such as American Forests' developing landowner resource hub, Sustainable Northwest's Post-Fire Reforestation Guidebook for Non-Industrial Private Forestlands in Eastern Washington, and the Reforestation, Nurseries, and Genetics Resources Directory and Marketplace initiative, can accelerate this development. This could also include features to connect contractors with project opportunities.

Fostering robust collaboration and strategic partnerships is the only way forward to overcome the challenges in reforestation. This entails actively strengthening partnerships among federal agencies, ODF, Tribal governments, private landowners, non-profits, research institutions, and community stakeholders. Recognizing that a unified, integrated approach is essential for long-term success means we must address and bridge perceived divides. The Pacific Northwest Reforestation Network (PNRN), currently in development, represents a pivotal opportunity to bring unprecedented value to regional reforestation efforts. By fostering a formal, collaborative structure, the PNRN can strategically streamline coordination, dismantle bottlenecks, optimize the seed supply, and bolster workforce development. Moreover, its pooled technical expertise will be instrumental in defining the core attributes of effective funding mechanisms, with member organizations leveraging their advocacy capabilities to translate these insights into concrete policy changes and proactive solutions.

Finally, prioritizing and securing dedicated funding is crucial for obtaining the necessary financial support. This means advocating for and securing dedicated, long-term funding mechanisms to support all facets of reforestation efforts that include site preparation, seed collection, planting, maintenance, wildfire risk reduction, climate adaptation strategies, workforce development, and the establishment and maintenance of infrastructure like a centralized information hub. Special attention should be given to simplifying funding access for small woodland owners through simple reforestation funds with fixed cost-share rates.

Remaining Gaps and Future Research

While this assessment provides a strong foundation, several critical gaps and areas for future research remain to be addressed. A deeper economic analysis of reforestation strategies, including long-term returns on investment from ecosystem services, would significantly strengthen resource allocation and support efforts to secure alternative funding or investments. While wildfire projections are included, a more nuanced understanding of how other large-scale disturbances (e.g., insect outbreaks, disease, and windthrow events) might impact future reforestation needs is warranted. Further analysis is needed to understand why demand does not align with need, which will better inform recommendations and approaches to increase demand for necessary reforestation efforts. Seed orchards, collection, germination success, and storage warrants further analysis to better understand seed needs and nursery capacity. Finally, comparing Oregon's reforestation projections and strategies with similar efforts in neighboring states offers valuable insights and opportunities for regional synergy, supporting broader reforestation strategies and policy support.

Oregon is better positioned to achieve its reforestation goals through the implementation of these recommendations and the proactive resolution of identified research and capacity gaps, thereby supporting the development of more resilient, biodiverse, and productive forests that contribute to the region's economic, social, and ecological well-being.