



ADVENTURE SCIENTISTS

# REFORESTATION: WESTERN U.S.

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PROJECT REPORT

December 2024

A partnership with  **Mast**  
REFORESTATION





**Volunteer Roxana Rojas scouts for cones during a field training event in Tahoe National Forest, California.**

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# REFORESTATION: WESTERN U.S.

1,290

Surveys submitted



9

Average Miles Hiked



136

Active Volunteers

15

National Forests Surveyed



67

Montana Volunteers



69

California Volunteers



# SUMMARY

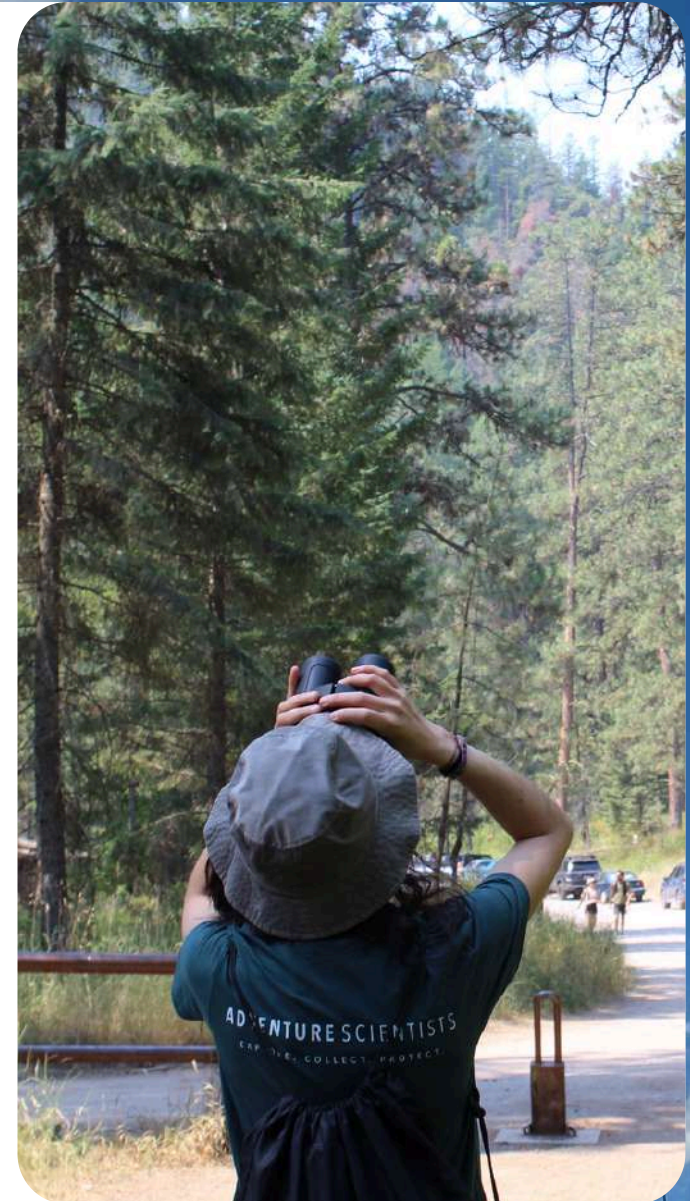
PREPARED BY MICHELLE TOSHACK

Adventure Scientists completed the second successful season of the *Reforestation: Western U.S.* project in 2024. In collaboration with Mast Reforestation, volunteers identified seed cones from nine conifer species: Douglas fir, Engelmann spruce, Jeffrey pine, red fir, white fir, incense cedar, western larch, lodgepole pine, and ponderosa pine.

Knowing the location and abundance of these cones is crucial for sourcing seeds for widespread reforestation efforts that help ecosystems recover from disturbances like wildfires and timber harvests.

Adventure Scientists' volunteers completed 1,290 cone surveys across seven national forests in Montana and eight national forests in California, more than doubling the data collected in 2023.

These data can be used by Mast Reforestation to identify areas with the highest cone production.



# PROJECT CONTEXT

Forests provide essential ecosystem services such as water filtration, carbon sequestration, and soil stabilization. Due to natural and man-made disturbances, there is an increasing need for reforestation efforts.



Around the world, forests are facing threats such as climate change, wildfires, natural disasters, disease, and insect outbreaks. Forests are unable to regenerate naturally at the rate that is necessary for seedlings to develop into healthy forests.

Tens of millions of hectares are potentially reforestable in the United States. However, there is a seed shortage for native conifer seeds which is limiting the ability to implement reforestation projects.



# PROJECT CONTEXT

Due to seed shortages, reforestation efforts have been increasingly difficult to implement. Wild seed (or 'woods run') collections harness local adaptations and preserve genetic diversity, ensuring planted seedlings have the best chance at survival. In order to collect cones in wild stands, highly trained collectors must learn to identify, monitor, and access locations with abundant cone crops.



Specialized seed collectors must know the locations of high-producing cone crops in order to target their seed-collection efforts.

As forest disturbance events increase in the future, seed availability may become more limited as trees have less time to produce viable seed between disturbances. This makes the need for conifer seed collections all the more pressing.



# WHAT IS MASTING OR MAST SEEDING?

Tree species mass produce cone crops in synchrony across a large geographic area, known as masting or a mast event.

Mast events do not take place on a regular schedule, making it challenging to know where and when to collect seeds.

Masting may be triggered by the effects of climate factors which affect conifer seed and cone development.





# THE IMPORTANCE OF SEEDLING PRODUCTION

The peak of seedling production in the United States was in the 1980's, when more than 2.6 billion seedlings per year were cultivated in the southern U.S. alone.

Since then, there has been a steady decrease of seedling production as seed storage, processing, and nursery facilities have shut down.

There is a pressing need to increase the availability of seeds to meet the reforestation demands throughout the United States



# PROJECT DESIGN

## What cones were surveyed?

Female cones produce seeds whereas male cones hold pollen. Volunteers completed surveys for closed, female cone crops. It was important for volunteers to survey closed cones to ensure seeds had not fallen out or been eaten by animals.

While determining the location of a cone crop, volunteers were also asked to identify the abundance of cones present in one of three categories: heavy, moderate, or light.

## What tree species were surveyed?

Cone crops were surveyed for nine conifer tree species: Douglas fir, Engelmann spruce, Jeffrey pine, red fir, white fir, incense cedar, western larch, lodgepole pine, and ponderosa pine.



Closed, female cone



Open, female cone



Male pollen cone



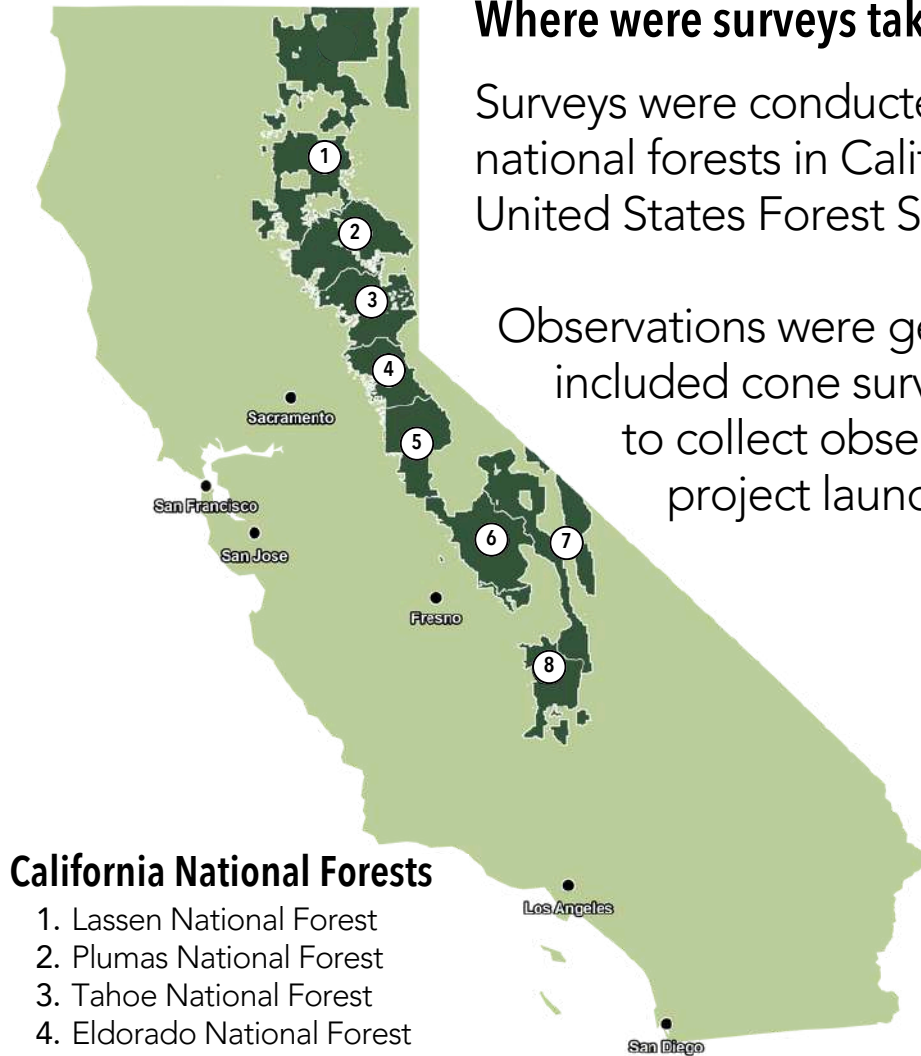
Tree gall, abnormal growth

# PROJECT DESIGN

## Where were surveys taken?

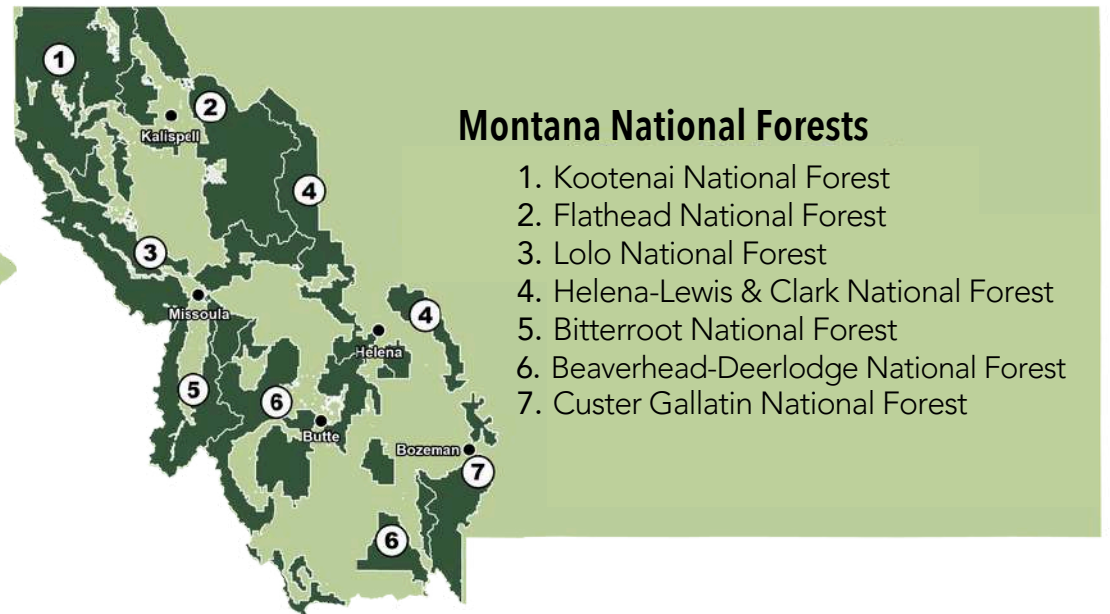
Surveys were conducted in seven national forests in Montana and eight national forests in California. Volunteers were encouraged to survey along United States Forest Service roads and up to one mile on trails.

Observations were geographically distributed within national forests and included cone surveys and absence data. We obtained permission to collect observational data on U.S. Forest Service land prior to project launch.



### California National Forests

1. Lassen National Forest
2. Plumas National Forest
3. Tahoe National Forest
4. Eldorado National Forest
5. Stanislaus National Forest
6. Sierra National Forest
7. Inyo National Forest
8. Sequoia National Forest



### Montana National Forests

1. Kootenai National Forest
2. Flathead National Forest
3. Lolo National Forest
4. Helena-Lewis & Clark National Forest
5. Bitterroot National Forest
6. Beaverhead-Deerlodge National Forest
7. Custer Gallatin National Forest

# PROJECT DESIGN

## How were volunteers trained?

Adventure Scientists required volunteers to complete comprehensive online training before collecting data. The training included project goals, reforestation and mast seeding background, tree species identification, and cone crop surveying protocols. We also hosted two in-person training events to give volunteers additional training opportunities: one in Soda Springs, California, and one in Missoula, Montana.

## How were surveys analyzed?

As volunteers submitted cone crop surveys and absence data, the observations populated a live project map on the Adventure Scientists' website. Mast Reforestation had access to a customized data dashboard to assess data quality throughout the project and observe cone crop information.



# DATA COLLECTION & RESULTS

## How did we meet project goals?

In 2024, Adventure Scientists added to a geographically distributed dataset of cone crop abundance for national forests across Montana and California. By submitting more than double the amount of surveys, volunteers provided landscape-level data to Mast Reforestation that directly supports their seed collection efforts to restore conifer forests in the western United States. The surveys conducted by volunteers in 2023 and 2024, from June to August, can help Mast Reforestation understand how cone crop production varies from year to year and will inform future cone collection efforts.

### SURVEYS COLLECTED IN CALIFORNIA NATIONAL FORESTS



### SURVEYS COLLECTED IN MONTANA NATIONAL FORESTS

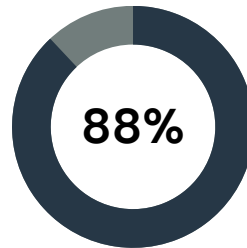


# VOLUNTEER EXPERIENCE

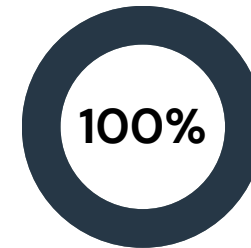


A volunteer scouts for cones in Lolo National Forest, Montana

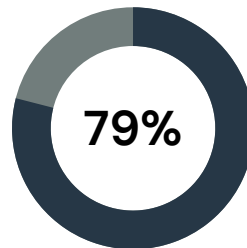
Following project completion, Adventure Scientists surveyed *Reforestation* project volunteers through an online form to gain feedback on volunteer experience (32% response rate). Highlights included the following:



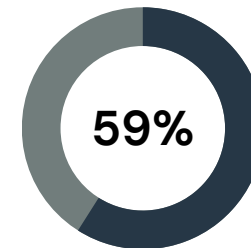
of volunteers reported learning a new skill



reported gaining a greater understanding of conifer tree and cone identification



reported feeling that they protected a place that was important to them



of volunteers returned from 2023

# 2024 VOLUNTEER EVENTS

Adventure Scientists hosted two volunteer field events: one in Soda Springs, California, and one in Missoula, Montana. After completing the training, volunteers searched for cones in nearby national forests. Over 50 people attended the events and worked together to complete 180 cone surveys in the surrounding forests.



# OUR SCIENTIFIC PARTNERS



**Mast Reforestation** is a Seattle-based company that focuses on scaling reforestation through carbon projects, nursery and seedling production, and scaling the overall seed supply for conifer forests in the Western US. The company aims to build an accessible seedbank suited for the anticipated seed migration needs of our changing climate. Seed is banked at Silvaseed in Roy, Washington and is available to anyone looking to grow seedlings.

## Carson Herold

*Seed Program Manager, Mast Reforestation*

*"The coverage of the data was critical. We can't cover all this ground by ourselves. It is really important that we have the ability to collect cone crop data across big landscapes. It's one of my favorite things about this partnership."*





# VOLUNTEER QUOTES

*"This was my second year of cone scouting, and I was struck by the contrast between the two years. In 2023 I found very few cones of any species, and came away with the impression that it must be very difficult to find good crops. This year there were cone crops nearly everywhere I went, with multiple species producing. This was a new way of appreciating the rhythms and beauty of places I already loved. Every project offers the potential for expanding our understanding and experience of the outdoors." - Dylan Kuhn*

*"I think the most impactful experience during the survey was our unintentional discovery of the burn scar of the Caldor wildfire in El Dorado National [Forest]... We did several surveys before we were presented with a very stark example of exactly why we are doing the project... The overlooks and scenic vistas along this route showed devastation as far as we could see but there were surprisingly large areas that survived. We found our best examples of Incense Cedars in mast in these surviving pockets." - Jonathan DuBose*

# PROJECT PRESS

## REVIVING RURAL LANDS: THE ESSENTIAL CONTRIBUTION OF VOLUNTEERS IN FOREST RECOVERY



 AGDAILY

September 2, 2024

“Through this collaboration, not only are local landscapes restored, but rural communities benefit from increased employment opportunities and enhanced environmental health. This collective effort shows how citizen science and community partnerships can drive positive change in forest recovery.”

- Suzanne Downing

## ADVENTURE SCIENTISTS LAUNCHES REFORESTATION INITIATIVE: A CALL TO OUTDOOR ENTHUSIASTS



 Sierra Sun

July 26, 2024

“This project has a reduced barrier to access—almost anybody can participate. We provide binoculars and training,” Futritski said. “This is a way for us to bring together and activate the community.”

-Alisa Futritski

## FREE TRAINING, BREAKFAST, BEER ON TAP FOR CITIZEN-SCIENCE SEED SURVEY



 Missoulian  
Every minute. Every day.

July 15, 2024

“Getting outside is often touted as a way to disconnect from smartphones and other screens – but a new citizen-science initiative in Montana hopes to get people and their phones outdoors with the goal of helping reforestation.”

-Joshua Murdock

# ACKNOWLEDGMENTS



We are grateful for the generous support of this work from the Yellowstone Club Community Foundation and private donors who support Adventure Scientists.

We would also like to thank AllTrails, MiiR, Mystery Ranch, Nocs Provisions, and Sunski for helping us increase accessibility to the outdoors and express appreciation to our volunteers with great incentives throughout the field season.

Special thanks to our scientific partners, Mast Reforestation, and to their dedicated teams of researchers, especially Carson Herold.



# THANK YOU, VOLUNTEERS!

We want to extend our appreciation to our incredible volunteers. We couldn't have gathered this critical data without their time and effort, and we are thankful for their passion, enthusiasm, and dedication to our mission!

“ I had a great time sharing the project with a friend of mine while hiking. We joked about how I was officially a "Cone Scout" ...we both appreciated the importance of the project and the joy of getting to contribute to conservation in the area.” - Montana volunteer

“It was a great opportunity venture out, learn and make a difference together as a family and have fun.” - California volunteer



Alisa Futritski leads a group of volunteers to scout cones in Lolo National Forest at a volunteer training day.

# REFERENCES

- Clark-Wolf, K., Higuera, P. E., & Davis, K. T. (2022). Conifer seedling demography reveals mechanisms of initial forest resilience to wildfires in the northern Rocky Mountains. *Forest Ecology and Management*, 523, 120487.
- Fargione, J., Haase, D.L, Burney, O.T., et al. (2021). Challenges to the Reforestation Pipeline in the United States. *Frontier in Forests and Global Change*, 4(629198), 1-18.
- Nolan, R.H., Collins, L, Leigh, A., et al. (2021). Limits to post-fire vegetation recovery under climate change. *Plant, Cell & Environment*, 44(11), 3471-3489.
- Roland, C. A., Schmidt, J. H., & Johnstone, J. F. (2014). Climate sensitivity of reproduction in a mast-seeding boreal conifer across its distributional range from lowland to treeline forests. *Oecologia*, 174, 665-677.
- United States Forest Service. (2023). State and Tribal Nurseries. Managing the Land. <https://www.fs.usda.gov/managing-land/forest-management/vegetation-management/nurseries/state-and-tribal>
- Wion, A. P., Pearse, I. S., Rodman, K. C., Veblen, T. T., & Redmond, M. D. (2021). The effects of ENSO and the North American monsoon on mast seeding in two Rocky Mountain conifer species. *Philosophical Transactions of the Royal Society B*, 376(1839), 20200378.



# PHOTO CREDITS

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