



ADVENTURE SCIENTISTS

# REFORESTATION: WESTERN U.S.

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PROJECT REPORT

December 2023

A partnership with  **Mast**  
REFORESTATION





**Volunteer CJ Chao  
scouts for conifer  
cones in Tahoe  
National Forest,  
California.**

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# REFORESTATION: WESTERN U.S.

635

Surveys submitted



13

Average Miles Hiked



56

Montana Volunteers



122

Successful Volunteers



15

National Forests Surveyed



66

California Volunteers

# SUMMARY

PREPARED BY JESSICA EGGERS AND ALISON ORMSBY, ADVENTURE SCIENTISTS

Adventure Scientists completed a successful season of the *Reforestation: Western U.S.* project in 2023. *Reforestation* was a new project for the organization, with a goal of identifying seed cones from nine conifer (evergreen, cone-producing) species. Knowing the location and abundance of these cones is crucial for sourcing seed for widespread reforestation efforts that help ecosystems recover from disturbances like wildfires and timber harvests.

Adventure Scientists' volunteers surveyed cone crops of nine conifer species reporting abundance and location data across seven national forests in Montana and eight national forests in California.

Our partners at Mast Reforestation will use these data on where cones are being produced in the greatest quantities to inform targeted cone collection for reforestation projects.



# PROJECT CONTEXT

Forests across the globe are being devastated by wildfires, climate change, natural disasters, disease, and insect outbreaks. These **disturbances are reducing the ability for forests to regenerate** – to establish seedlings that eventually become mature trees in a forest.



Given the vital ecosystem services that forests provide, such as wildlife habitat, carbon sequestration, clean water, and soil stability, there is an **increasing need for reforestation efforts.**

However, the **availability and access to native seed limits the ability for lands to be reforested.** Currently, the United States Forest Service is only able to re-plant approximately 20% of national forest lands that need reforestation (Fargione et al., 2021)



# PROJECT CONTEXT

Native seed used for reforestation efforts has become **increasingly dependent on harvesting cones from non-commercial forests**. Highly trained collectors are required for high-volume, wild seed harvest. Seed collectors must learn to identify, monitor, and access locations with abundant cone crops or mast seeding events.



It is important for these specialized collectors to **target their efforts to areas with high-producing cone crops**.

There is urgency in making these collections. **Seed availability is likely to become more limited in the future**, as trees have less time to produce viable seed between more frequent disturbances.



# WHAT IS "MASTING" OR "MAST SEEDING"?

**Mast seeding is the synchronized, mass production of seed crops across a large geographic area.**

Mast seeding is intermittent, not taking place annually or on a regular schedule.

Researchers believe that mast seeding is likely triggered by the effects of climate factors, such as summer precipitation, which affect conifer seed and cone development.



# SPOTLIGHT ON SEEDLING PRODUCTION

Across the United States, **seedling production was at an all-time high in the 1980s**, producing more than 2.6 billion seedlings per year in the southern U.S. alone.

Since then, **seed storage, processing, and nursery facilities have been shutting down**, steadily decreasing seedling production.

Currently, there is a **need to significantly increase seed availability** to meet the nation's growing reforestation demands.



# PROJECT DESIGN

## What cones were surveyed?

Volunteers surveyed closed, female cone crops. Female cones contain seeds needed for reforestation efforts, compared to male cones, which hold pollen. Closed cones were needed to ensure seeds had not fallen out or been eaten by animals before Mast Reforestation's collectors could harvest them.

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 seed cone

Open, female cone



Male pollen cone

Tree gall, abnormal growth

# PROJECT DESIGN

## Where were surveys taken?

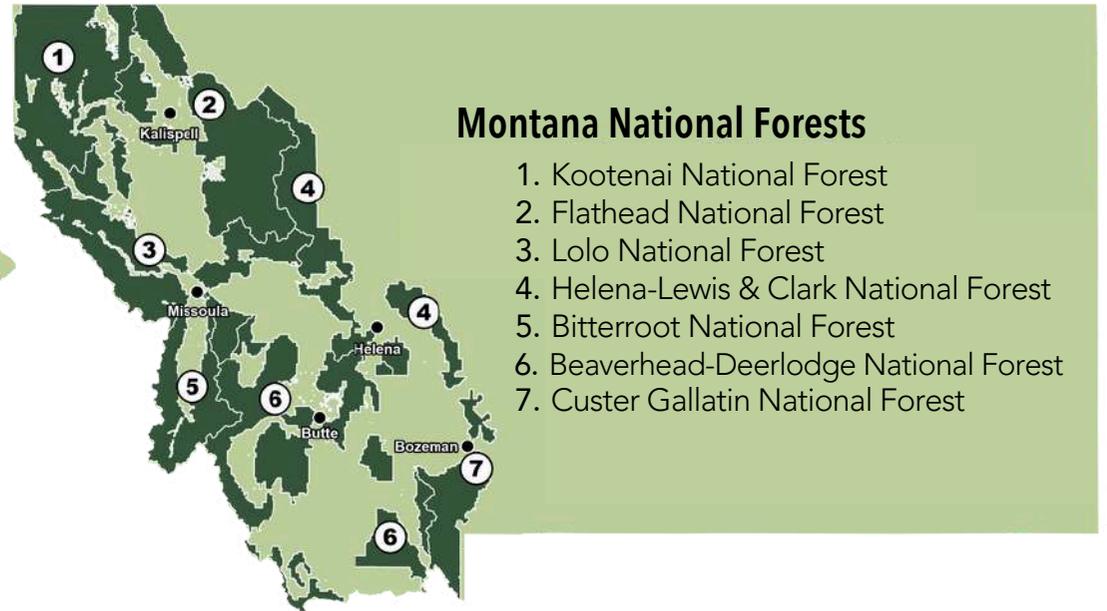
Surveys were conducted in seven national forests in Montana and eight national forests in California. Volunteers were encouraged to survey along United States Forest Service roads and up to one mile on trails.

Survey density did not exceed five data points per square mile and observations were geographically distributed within national forests. We obtained permission to collect observational data on U.S. Forest Service land prior to project launch.



### California National Forests

1. Modoc National Forest
2. Lassen National Forest
3. Plumas National Forest
4. Tahoe National Forest
5. Eldorado National Forest
6. Stanislaus National Forest
7. Sierra National Forest
8. Inyo National Forest
9. 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

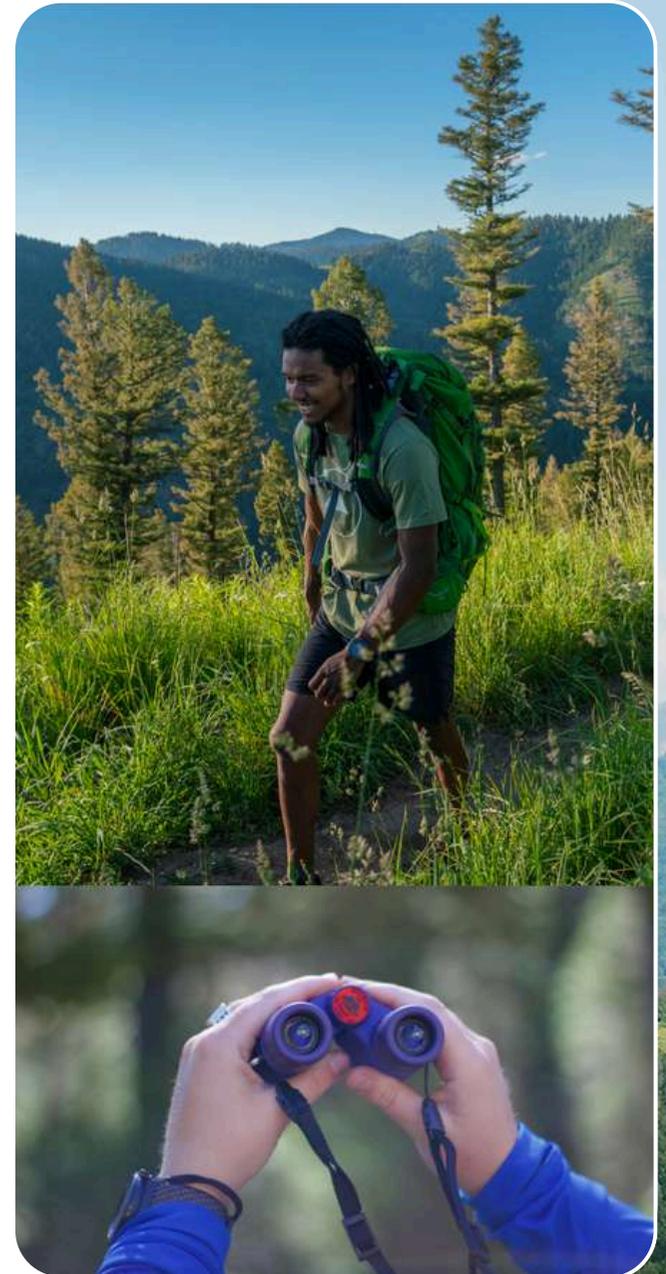
# PROJECT DESIGN

## How were volunteers trained?

Prior to data collection, volunteers were required to complete a comprehensive online training. Volunteers learned about project goals, background on reforestation and mast seeding, tree species identification, and cone crop surveying protocols. The training was hosted online on the Volunteer Homepage to provide greater accessibility and streamline the training process, a new addition for Adventure Scientists.

## How were surveys analyzed?

As volunteers collected and submitted cone crop surveys, a live view of the data was made available on the Adventure Scientists' website. A customized data dashboard was created for the Mast Reforestation staff, allowing them to assess data quality during the active data collection period of the project. Data quality review resulted in direct and timely improvements to the field protocols.



# DATA COLLECTION & RESULTS

## How did we meet project goals?

In our first season of the *Reforestation* project, Adventure Scientists successfully built a geographically distributed dataset of cone crop abundance for national forests across Montana and California. Our 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 can be built upon in future seasons, helping us to understand how cone crop production varies from year to year, and informing cone collection efforts.

### SURVEYS COLLECTED IN CALIFORNIA NATIONAL FORESTS



### SURVEYS COLLECTED IN MONTANA NATIONAL FORESTS



# VOLUNTEER EXPERIENCE



Volunteer Andrea Clulow scouting for cones in Inyo National Forest, CA.

Following project completion, in August 2023, Adventure Scientists surveyed *Reforestation* project volunteers through an online form. There were 56 responses, representing 46% of volunteers.

**Volunteers' primary motivators** to volunteer for the *Reforestation* project: caring about the project's conservation themes (35%); wanting to help Adventure Scientists with their mission (18%); and enjoying learning about science and nature (14%).



Volunteer Sam Kulla scouted for cone crops in Lolo National Forest, Montana, writing that his 4-year old daughter "has been bringing me pinecones non-stop since our field days, she's still at it!"

# VOLUNTEER EXPERIENCE

Through project participation, 92% of volunteers **learned a new skill**. Furthermore, 96% gained a greater understanding of conifer tree and cone identification.

80% of volunteers felt that they **protected a place that was important to them**.

One incredible volunteer **hiked 90 miles** during the project scouting for conifer cones in California!



Volunteer Chantal Bussiere scouted for cones in the Flathead and Kootenai National Forests of Montana, expressing, *"I'm a proud steward of the land and take any opportunity to educate people about the ecosystems we live in."*



Volunteers James Ginther and Olivia Duba identifying cone crops with their trusty pup in Stanislaus National Forest, CA.



# TAHOE VOLUNTEER EVENT

In June 2023, Adventure Scientists hosted a multi-day volunteer recruitment event in Tahoe City, California. In partnership with Big Blue Adventure, Adventure Scientists' staff hosted a booth during the Tahoe Mountain Bike Race and Burton Creek Trail Run.



At the booth, bikers, runners, and family members learned about the *Reforestation* project and the opportunity to scout for cones in California National Forests.



Additionally, a meet and greet was hosted at a local restaurant, allowing existing and new volunteers to socialize and ask questions about the sampling methods. The volunteer event was a big success, as the greatest number of California surveys were collected in Tahoe National Forest.

# 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.

Over the past three years, Mast Reforestation has collected almost 20,000 bushels of cones, resulting in nearly 15,000lbs of conifer seed, and aims to further scale collections for a sustainable seed supply chain. They need targeted cone collection driven by on-the-ground data about where cones are being produced.

## Felicia Froton

*Seed Program Manager,  
Mast Reforestation*



*"The data the volunteers provided enabled us to make quick decisions in order to collect where the cone crop was occurring, or to not spend resources and effort where there was not a cone crop. This was all possible because we had the coverage and data from our citizen science network."*

- Felicia Froton

# VOLUNTEER QUOTES

*"Got me out of my routine and into the great outdoors under the forests.....ahh breathe some fresh air! I felt good about contributing to a meaningful research project, with a goal of reforesting damaged fire scars and insect infestation die-off areas. A worthwhile cause."*

*"This project was a great motivator for me to get my family and friends hiking with me. Instead of just hiking to get to a destination, we explored our surroundings closer and simply enjoyed the journey."*

*"During my time volunteering with Adventure Scientists, I was able to experience the beauty of Montana for the first time. In addition to my time seed scouting in the Beaverhead Deerlodge National Forest, I was able to visit the town of Deer Lodge where my mother was born, mine for sapphires, and off-road to visit the Garnet ghost town. These memories and experience I will always treasure!"*



# PROJECT PRESS

## ADVENTURE SCIENTISTS HOSTS MISSOULA PINE CONE HUNT



July 09, 2023



“Those seeds will then be collected in the cones by our partners at Mast Reforestation and used to build a seed bank and seedlings to reforest areas after forest fires, insect invasions — so rebuilding our forest communities,” explained Jessica Eggers with Adventure Scientists.

## NONPROFIT ASKS CITIZEN SCIENTIST HELP GATHER DATA IN NATIONAL FORESTS



July 03, 2023



“I have volunteered for Adventure Scientists on numerous projects, and I really enjoy being able to give back while also being outdoors,” said Pam Hault, from the Bay area and a current volunteer with the Reforestation: Western US project. “The Reforestation project is fun and easy, and working with Adventure Scientists gives us the impetus to explore new places as well as our tried and trusted favorites.”

# 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, GaiaGPS, MiiR, Mystery Ranch, Nocs Provisions, Outdoor Research, 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: Felicia Froton; Carson Herold; Luke Hawbaker; and Nastassia Barber.

Finally, 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.

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# PHOTO CREDITS

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