ADVENTURE SCIENTISTS

EXPLORE. COLLECT. PROTECT.

REFORESTATION: WESTERN U.S.

PROJECT REPORT

December 2023

A partnership with **Mast** REFORESTATION

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

CONTENTS

___

635
Surveys submitted

122
Successful Volunteers

15
National Forests Surveyed

13
Average Miles Hiked

56
Montana Volunteers

66
California Volunteers

SUMMARY

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, 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 conecrops.

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

Closed, female seed cone

Open, female cone

Male pollen cone

Tree gall, abnormal growth

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.

PROJECT DESIGN

Surveys were conducted in seven national forests in Montana and eight national forests in California. Volunteers were limited to surveying along United States Forest Service (USFS) roads and up to one mile in trails.

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

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

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

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 Adventure Scientists Volunteer Homepage on our website in order to provide greater accessibility and streamline the training process.

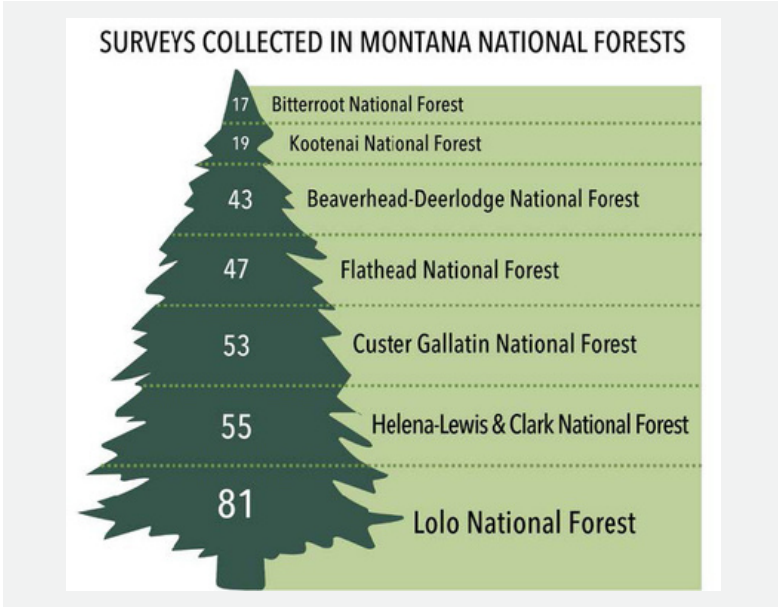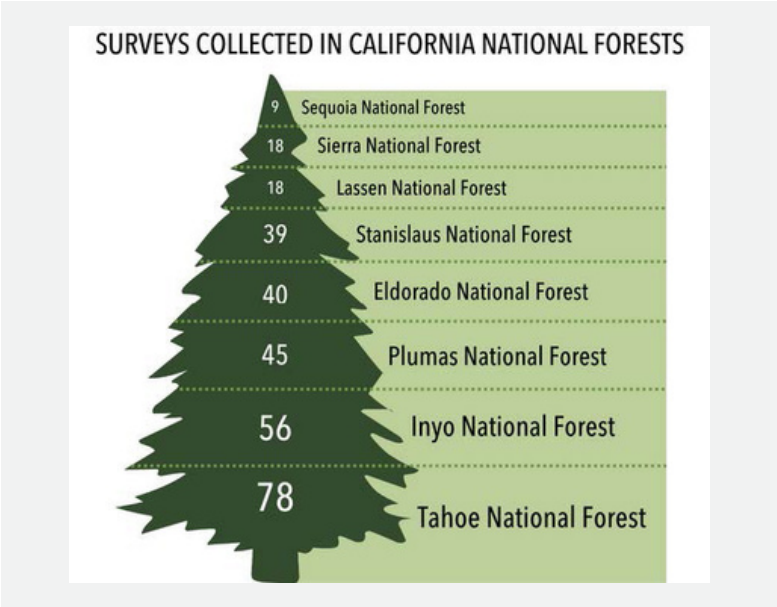**How were surveys analyzed?**

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

9	Sequoia National Forest
18	Sierra National Forest
18	Lassen National Forest
39	Stanislaus National Forest
40	Eldorado National Forest
45	Plumas National Forest
56	Inyo National Forest
78	Tahoe National Forest

SURVEYS COLLECTED IN MONTANA NATIONAL FORESTS

17	Bitterroot National Forest
19	Kootenai National Forest
43	Beaverhead-Deerlodge National Forest
47	Flathead National Forest
53	Custer Gallatin National Forest
55	Helena-Lewis & Clark National Forest
81	Lolo National Forest

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, wrote that his young daughter joined an outing and "has been bringing me pinecones non-stop since our field days, she's still at it!"

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

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."

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 supplyfor conifer forests in the Western US. The company aims to build an accessible seed bank 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 15,000 lbs 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 Reforstation

"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

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.

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 — 8KPAX
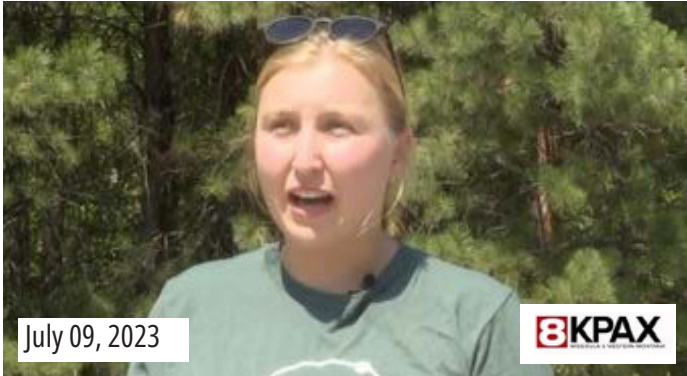
"Those seeds will then be collected in the cones by our partners at Mast Reforestation and used to build a seed bank and seedlings to reforest areas after forest fires, insect invasions– so rebuilding our forest communities," explained Jessica Eggers with Adventure Scientists.

NONPROFIT ASKS CITIZEN SCIENTIST HELP GATHER DATA IN NATIONAL FORESTS

July 03, 2023 — Tahoe Daily Tribune

"I have volunteered for Adventure Scientists on numerous projects, and I really enjoy being able to give back while also being outdoors," said Pam Hoult, 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

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.

ADVENTURE SCIENTISTS

EXPLORE. COLLECT. PROTECT.

PO BOX 1834 | BOZEMAN, MT 59771
406.624.3320
info@adventurescientists.org
For more information:
www.adventurescientists.org