Environment and Natural Resources Trust Fund

2027 Request for Proposal

General Information

Proposal ID: 2027-031

Proposal Title: Recovering and Restoring Rare Native Minnesota Eastern Hemlocks

Project Manager Information

Name: David Remucal

Organization: U of MN - Landscape Arboretum

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Project Basic Information

Project Summary: Restore native germplasm and revive resiliency of native hemlock trees in Minnesota through collection and propagation of genetically-identified native seeds and cuttings. Enable repopulation project in collaboration with the DNR.

ENRTF Funds Requested: $170,000

Proposed Project Completion: June 30, 2030

LCCMR Funding Category: Small Projects (G)

Secondary Category: Fish and Wildlife (D)

Project Location

What is the best scale for describing where your work will take place?

Region(s): NE

What is the best scale to describe the area impacted by your work?

Region(s): NE

When will the work impact occur?

During the Project and In the Future

Narrative

Describe the opportunity or problem your proposal seeks to address. Include any relevant background information.

Eastern hemlock, while never known to be common, was historically present in multiple northeastern Minnesota locales, including a ~280-acre Paupore stand largely destroyed by the 1918 Cloquet fire; today, only around 50 mature trees remain largely concentrated in a single native population, and the species is listed as Endangered in MN and near threatened range-wide by IUCN. Several populations have been lost entirely. Initial genetic analyses of some known planted stands of unknown origin in Grand Rapids, Cloquet and Chaska are showing evidence these trees come from a likely extirpated Mille Lacs population, and perhaps even from other of the lost populations.
The University of Minnesota Landscape Arboretum's (UMLA) long-term rare plant seedbank has seed from most of these native and unknown-origin sites and has also been working on creating vegetative propagules from the lost population trees. With a more complete genetic analysis of these trees and their seedlings, as well as a few more recently identified, potentially native individual trees and small stands, we will be able to determine which trees are native and if stands are producing true native offspring. This genetic banking and tree production capability represents a path for bolstering native genetics for this species.

What is your proposed solution to the problem or opportunity discussed above? Introduce us to the work you are seeking funding to do. You will be asked to expand on this proposed solution in Activities & Milestones.

We will use genetic analyses to determine which remaining eastern hemlock trees and seedbank materials in Minnesota represent true native lineages. This verification will allow us to confidently identify and prioritize genetically appropriate material for conservation and restoration. Verified native germplasm will be propagated and planted as hemlock stands in protected natural areas, helping to preserve, reconnect, and strengthen the state's remaining native genetic diversity.

1. Identify and collect cuttings from target isolated and small stand hemlock locations for both propagation and genetic analyses.
2. Apply Genotyping-by-Sequencing (GBS) to (a) adult trees of unknown provenance (analyzed by location/population) and (b) subsets of seedlings, stratified by maternal source to assess genetic diversity/relatedness and condition of Minnesota provenance, and guide planting designs that maximize adaptive potential and preserve potentially important regional genetic diversity. With woolly adelgid decimating this species across its range, Minnesota's edge-of-range native genetics could be vital to the survival of this species.
3. Propagate and grow at least 200 hemlock saplings following Minnesota-adapted protocols using both seed and root-grafted cuttings from genetically-identified native trees, while incorporating horticultural sanitation practices to ensure weed/pest-free stock. Prepare stock for transfer to DNR as needed.

What are the specific project outcomes as they relate to the public purpose of protection, conservation, preservation, and enhancement of the state's natural resources?

Native hemlock genetics in the state is disappearing, through splintering and isolation as well as by dilution through planting of non-native hemlocks in multiple locations. This project will identify and propagate the valuable native genetics that exist as unidentified shrinking stands and lone individuals that remain from the larger populations that used to inhabit the state. Creation of one or more new populations will be enabled in collaboration with DNR land managers and planners in isolation of planted non-natives to preserve this important native genetic material in a sustainable manner restoring resiliency to this iconic conifer in the state.

Activities and Milestones

Activity 1: Identification and collection of scattered remaining trees and stands

Activity Budget: $37,000

Activity Description:
Stands of trees in Grand Rapids and Cloquet will be targeted for cuttings and seed collections. Separately identified suspected native trees, including recently identified plants that may be remnants or offspring of a previously thought extirpated Mille Lacs population, and isolated stands at other locations will be targeted for cuttings collection only unless there is enough evidence that these locations are truly isolated from any non-native hemlock planted material which could dilute seed stock. Gather stem cuttings and/or seed from these trees as detailed above and transport them to UMLA for root grafting and genetic testing (Activity 2). Rootstock will be obtained ahead of time based on anticipated number of grafts available per season.

Activity Milestones:

Description	Approximate Completion Date
Collect seed from Grand Rapids and Cloquet sites	October 31, 2027
Collect cuttings from identified, isolated likely-native trees for grafting.	January 31, 2028
Collect addition cuttings from additional identified, isolated likely-native trees for grafting.	January 31, 2029

Activity 2: Finish genetic analyses of scattered trees of suspected native provenance

Activity Budget: $10,000

Activity Description:
Complete the genetic analyses of trees and seedlings of plants from the stands with trees of suspected MN provenance in Grand Rapids, Cloquet and UMLA using GBS sequencing and multivariate statistical analyses to determine relatedness. Additional individuals and small stands identified as potentially native in origin will also be targeted for inclusion in the genetic analysis. This analysis will be contracted through UMN genetic services and the results will determine whether banked/collected seed can be used for the population recovery or whether only the cutting propagules can be used. The goal is to create a new population with a genetically diverse, but native, set of trees.

Activity Milestones:

Description	Approximate Completion Date
Collect genetic material from remaining, unanalyzed trees for genetic sampling	October 31, 2027
Collect genetic material from seedlings produced from target populations.	October 31, 2027
Submit material to UMN Genomic Center for preparation and sequencing	October 31, 2027
Analyze GBS sequencing results, determining plan for plant production	August 31, 2028

Activity 3: Propagation of plants from seeds and/or cuttings

Activity Budget: $123,000

Activity Description:
Identification and propagation of individuals of likely native provenance. Using established seed propagation protocols, this project's plant production will be through seed germination and root-grafting. This effort will begin prior to the final genetic analyses have been completed so that when the analyses are done, we will already have material being generated. Any material that is found to be non-native can be used for rootstock for continued grafting efforts so no

material will be wasted. During propagation efforts, UMLA will work with DNR partners to identify continued plant care and outplanting responsibilities, as well as identify ideal outplanting locations based on the reintroduction standards and methods identified in LCCMR project 2022-193 which developed establishment methodology and tested habitat requirements for seedling of eastern hemlock. Total expected tree production numbers and the results of the genetic analyses will guide determination of the number of distinct genetic populations that should be created. Seedlings/saplings will be turned over to the DNR as decided upon completion of the granting period.

Activity Milestones:

Description	Approximate Completion Date
Propagation and protocol finalization for both seed and cutting propagation.	October 31, 2027
Begin propagation of seed and/or grafting propagules	March 31, 2028
Care and evaluation of propagules, starting a second set if necessary.	January 31, 2029
Final evaluation of propagules, with final plan for post-grant distribution of the propagated material.	June 30, 2030

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Holly Bernardo	MN DNR Ecological and Water Resource Division	Minnesota Biological Survey - Plant Survey Supervisor	No

Dissemination

Describe your plans for dissemination, presentation, documentation, or sharing of data, results, samples, physical collections, and other products and how they will follow ENRTF Acknowledgement Requirements and Guidelines.
We will share the story of the individual project through University of Minnesota Landscape Arboretum resources, as well as the general importance of Minnesota native plant conservation through educational flyers, displays, and interpretive signage. We will also provide project updates and additional information on the Arboretum and Plant Conservation Program websites, https://arb.umn.edu/ and https://arbconservation.cfans.umn.edu/. Education, information, and outreach are important aspects of the Arboretum's conservation work. Additionally, we will give presentations at several local or national conferences or meetings each year, which are additional opportunities to share this project and our conservation work. Our collaborators in this project, The Minnesota Department of Natural Resources, will also have the opportunity to inform their stakeholders about this work through their separate networks.

Finally, because this work will be done under several different permits, we will be making official reports of this project to the DNR.

The Minnesota Environment and Natural Resources Trust Fund (ENRTF) will be acknowledged through use of the trust fund logo or attribution language on project print and electronic media, publications, signage, and other communications per the ENRTF Acknowledgement Guidelines.

Long-Term Implementation and Funding

Describe how the results will be implemented and how any ongoing effort will be funded. If not already addressed as part of the project, how will findings, results, and products developed be implemented after project completion? If additional work is needed, how will this work be funded?
After genetic analyses and propagation, we would work with the DNR to determine best planting dates and locations as well as potential handoff of material to DNR Forestry for care past the granting period. We would also work with the DNR to ensure any future planting of these sites would be monitored and trees would be effectively protected until they are large enough to withstand deer.

Other ENRTF Appropriations Awarded in the Last Six Years

Name	Appropriation	Amount Awarded
Preserving and Protecting Minnesota Native Orchid Species	M.L. 2015, Chp. 76, Sec. 2, Subd. 08c	$167,000
Preserving Minnesota's Native Orchids - Phase 2	M.L. 2018, Chp. 214, Art. 4, Sec. 2, Subd. 08h	$259,000
Preserving Minnesota's Only Ball Cactus Population	M.L. 2021, First Special Session, Chp. 6, Art. 6, Sec. 2, Subd. 08d	$103,000
Minnesota's Volunteer Rare Plant Conservation Corps	M.L. 2022, , Chp. 94, Art. , Sec. 2, Subd. 08a	$859,000

Long-Term Preservation of Minnesota's Ball Cactus Population	M.L. 2024, , Chp. 83, Art. , Sec. 2, Subd. 08a	$100,000
Minnesota PlantWatch: Community Scientists Conserving Rare Plants	M.L. 2025, First Special Session, Chp. 1, Art. 2, Sec. 2, Subd. 08a	$1,086,000

Project Manager and Organization Qualifications

Project Manager Name: David Remucal

Job Title: David Remucal

Provide description of the project manager's qualifications to manage the proposed project.
Dr. Remucal is the Delores E. Isaacson Curator of Endangered Plants at the Minnesota Landscape Arboretum where he has developed and managed the Plant Conservation Program since its inception in 2013. A graduate of Carleton College, he received his PhD in plant reproductive ecology and evolution from the University of Colorado. He will provide overall project direction. As manager of the Plant Conservation Program, he has demonstrated the ability to manage and develop budgets, direct volunteers and staff, work with stakeholders, coordinate with remote and local partners, communicate program information and results to a variety of audiences, and expand the scope and influence of the MLA Conservation Program. As part of outreach and education for the program, he teaches and presents to multiple groups every year and works to reach a broad audience around the state. The Plant Conservation Program strives to work with a broad coalition of partners for its work, engaging with regional NGOs, federal, state and local governmental agencies and researchers and groups nationally and internationally-based. Remucal and the Plant Conservation Program has parlayed two previous LCCMR grants into a nationally-recognized orchid research and conservation program. Additional ENRTF supported projects have included augmentation of a rare cactus species in the state and a partnership with the DNR to form the successful MN PlantWatch citizen scientist program.

Organization: U of MN - Landscape Arboretum

Organization Description:
The U of MN Landscape Arboretum, founded in 1958, is a 1,200-acre premier northern garden that includes 28 specialty gardens, 45 plant and tree collections, 18 model landscapes and natural areas, and an extensive collection of northern hardy plants. Located 35 minutes west of Minneapolis-St. Paul, the Arboretum's 12.5 miles of garden paths and hiking trails welcome 500,000 visitors each year who are inspired by their explorations of nature, the many seasonal displays and exhibits, and hands-on educational programming. The Arboretum's mission is to welcome, inform and inspire all through outstanding displays, protected natural areas, horticultural research and education. Its vision is to be the premier northern landscape arboretum, welcoming all to enjoy, learn from and connect with nature.

The U of MN Landscape Arboretum was born out of the University of Minnesota's Horticultural Research Center and is an established, nationally recognized research institution that includes a Plant Conservation Program focused on developing and implementing conservation strategies for imperiled native plants of the upper Midwest region.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	$ Amount
Personnel								
UMLA Seed Conservation Biologist		Manage propagation efforts			24.4%	0.3		$32,000
Curator of Endangered Plants		Principal Investigator and project coordinator			26.7%	0.15		$22,000
UMLA Greenhouse Technician		Propagation and Greenhouse specialist at UMLA			24.4%	1.2		$88,400
UMLA Field Botanist		Seed and cutting collection			24.4%	0.15		$15,000
							Sub Total	**$157,400**
Contracts and Services								
University of Minnesota Genomics Center	Internal services or fees (uncommon)	DNA Extraction from 100 hemlock samples; GBS library preparation				-		$6,000
							Sub Total	**$6,000**
Equipment, Tools, and Supplies								
	Tools and Supplies	Sampling, greenhouse and planting supplies: Including shears and potting material	These tools and supplies will be needed for both the extraction of living cuttings material for grafting propagation and for seed germination and maintenance of plant material at greenhouses at UMLA.					$2,000
	Tools and Supplies	Hemlock rootstock	Purchase of 100 young eastern hemlock stock for root grafting (supplementing what UMLA can produce)					$700
							Sub Total	**$2,700**

Capital Equipment								
							Sub Total	**-**
Acquisitions and Stewardship								
							Sub Total	**-**
Travel In Minnesota								
	Miles/ Meals/ Lodging	Food and lodging during seed and/or live plant collection trips in Greater Minnesota more than 200 miles round trip for 1 person - $249/trip x 4 overnight trips total. Reimbursed based on University of Minnesota plan.	Lodging and per diem for UM staff to identify and collect seeds/cuttings from native hemlocks.					$1,800
	Miles/ Meals/ Lodging	Mileage reimbursement for seed and/or live plant collection trips - 400 miles round trip - $0.725 per mile x 6 round trips total. Reimbursed based on University of Minnesota plan 2026 rate.	Travel mileage for UM staff to identify and collect seeds/cuttings from native hemlocks.					$2,100
							Sub Total	**$3,900**
Travel Outside Minnesota								
							Sub Total	**-**
Printing and Publication								
							Sub Total	**-**
Other Expenses								
							Sub Total	**-**
							Grand Total	**$170,000**

Classified Staff or Generally Ineligible Expenses

Category/Name	Subcategory or Type	Description	Justification Ineligible Expense or Classified Staff Request

Non ENRTF Funds

Category	Specific Source	Use	Status	Amount
State				
			State Sub Total	**-**
Non-State				
			Non State Sub Total	**-**
			Funds Total	**-**

Total Project Cost: $170,000

This amount accurately reflects total project cost?

Yes

Attachments

Required Attachments

Visual Component

File: c77ef639-53c.pdf

Alternate Text for Visual Component

Visual description of overall project goals, to propagate native material for reintroduction to protected locations in the state....

Supplemental Attachments

Capital Project Questionnaire, Budget Supplements, Support Letter, Photos, Media, Other

Title	File
UMN Sponsored Projects Administration endorsement letter	8e633a0c-3b8.pdf

Administrative Use

Does your project include restoration or acquisition of land rights?

No

Do you understand that travel expenses are only approved if they follow the "Commissioner's Plan" promulgated by the Commissioner of Management of Budget or, for University of Minnesota projects, the University of Minnesota plan?

Yes, I understand the UMN Policy on travel applies.

Does your project have potential for royalties, copyrights, patents, sale of products and assets, or revenue generation?

No

Do you understand and acknowledge IP and revenue-return and sharing requirements in 116P.10?

N/A

Do you wish to request reinvestment of any revenues into your project instead of returning revenue to the ENRTF?

N/A

Does your project include original, hypothesis-driven research?

No

Does the organization have a fiscal agent for this project?

No

Does your project include the pre-design, design, construction, or renovation of a building, trail, campground, or other fixed capital asset costing $10,000 or more or large-scale stream or wetland restoration?

No

Do you propose using an appropriation from the Environment and Natural Resources Trust Fund to conduct a project that provides children's services (as defined in Minnesota Statutes section 299C.61 Subd.7 as "the provision of care, treatment, education, training, instruction, or recreation to children")?

No

Provide the name(s) and organization(s) of additional individuals assisting in the completion of this proposal:

Valerie Aas, University of Minnesota Landscape Arboretum

Do you understand that a named service contract does not constitute a funder-designated subrecipient or approval of a sole-source contract? In other words, a service contract entity is only approved if it has been selected according to the contracting rules identified in state law and policy for organizations that receive ENRTF funds through direct appropriations, or in the DNR's reimbursement manual for non-state organizations. These rules may include competitive bidding and prevailing wage requirements

N/A