Environment and Natural Resources Trust Fund
2020 Request for Proposals (RFP)

Project Title: **ENRTF ID: 260-FH**

Control Snowdrift Using Living Fences to Protect Wildlife

Category: H. Proposals seeking $200,000 or less in funding

Sub-Category: F. Methods to Protect, Restore, and Enhance Land, Water, and Habitat

Total Project Budget: $ 199,971

Proposed Project Time Period for the Funding Requested: June 30, 2023 (3 yrs)

Summary:

We propose to develop, study, and demonstrate living snow fences made of natural plants that balance ecological benefits and economical cost for protecting wildlife against snowdrift caused by winter storms.

Name: Lian Shen

Sponsoring Organization: U of MN

Job Title: Dr.

Department:

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Location:

Region: Statewide

County Name: Statewide

City / Township:

Alternate Text for Visual:

Due to plant loss, snowdrift during winter storms has been threatening wildlifes living space and food resources. Living snow fence is proposed for sheltering wildlife and maximizing ecological benefits.

_____ Funding Priorities	_____ Multiple Benefits	_____ Outcomes	_____ Knowledge Base
_____ Extent of Impact	_____ Innovation	_____ Scientific/Tech Basis	_____ Urgency
_____ Capacity Readiness	_____ Leverage	_____ TOTAL	_____%

PROJECT TITLE: Control Snowdrift Using Living Fences to Protect Wildlife

I. PROJECT STATEMENT

Background

Wildlife is an essential part of the ecosystem. Minnesota is home to a variety of wildlife, including about 83 mammal species and 319 bird species. Most of the wildlife lives in the forest and wetland. However, 98% of native forest and wetland were lost during the exploitation of Minnesota in the past over 100 years, and there were about 25,000 acres of wetland and 13,000 acres of forests converted into farmland between 2008 and 2012. Loss of trees and vegetations reduces the shelters for wildlife during winter storms. Without the blockage of plants, blowing and drifting snow develops, making it hard for wildlife to find food because of snow coverage. As a result, living through the winter becomes more challenging, especially for harsh winters like the past one. The Department of Natural Resources in the Whitewater Wildlife Management Area has received many reports of wildlife mortality due to the storms in 2018-2019 winter, and most of the dead animals are fawns born last summer. It has also been reported that many deer mortality cases happened due to the hitting by cars when the deer crossed the roads to find land with less snow coverage.

What is living snow fence?

Living snow fences are plants that are aligned to trap snow as it blows across field. The plants can be trees, shrub, native grasses, wildflowers, or even a few rows of crops intentionally left behind.

The benefit of living snow fence

The low visibility and difficulty of foraging on snow-covered land caused by blowing snow and snowdrift are the main threats to wildlife during winter storms. Snow fences serve as barriers that control blowing and drifting snow. Compared with man-made structures, living snow fences need less maintenance and have many ecological benefits: they can provide food resources and nesting spots for birds; animals, such as deer and rabbits, can reside and feed young ones in living snow fences and shelter from predators; and such fences can create stable habitat, which is critical for attracting and preserving wildlife.

Objectives of this study

The objectives of this proposal are to create an efficient and economic living snow fence design (in terms of plant species, density, spatial distribution, etc.) by studying the impacts of the fences on blowing snow and snowdrift. Such design will maximize the ecological benefits under the limitation of economy cost (e.g., occupied farm land, reduced crop yield, maintenance cost, etc.). By broadly applying the outcomes of this project across Minnesota, we expect to invoke the awareness of landowners on preserving wildlife in winter.

Research tasks

To achieve the above objectives of this project, we will: 1) test different designs of living snow fences under various environment conditions; 2) establish a database on the relation between fence design and snow distribution; 2) find the optimal design; 3) deploy the optimized living snow fences in the field; 4) monitor the wildlife activities around the fences; 5) publish our research outcomes and outreach to the general public and Minnesota landowners.

II. PROJECT ACTIVITIES AND OUTCOMES

Activity 1 Title: Find optimal design of living snow fences.
Description: We will collect data from field observation and laboratory experiment to quantify the effects of living snow fences on blowing and drifting snow. We will find the optimal snow fence design for a variety of terrain and climate conditions across Minnesota. We will develop a model to obtain fast and accurate ground snow distribution for given living snow fence design, and we will associate the capitalization of ecology resources for the balance between economy and ecology.

ENRTF BUDGET: $69,989

Outcome	Completion Date
1. Data collected from field observations across Minnesota.	March 31, 2021
2. Data collected in laboratory experiments in SAFL.	March 31, 2022
3. Optimized living snow fence design for different places across Minnesota.	June 30, 2022
4. A model that can get fast and accurate result about snow distribution.	Dec. 31, 2022

Activity 2 Title: Test the optimized living snow fence in the field.
Description: We will apply our living snow fence design at different sites in the field. Field investigation will be conducted in winter storm events to validate its effect on snowdrift control. We will keep monitoring the activities of wild animals in and around the fences during winter to see how the living snow fences protect wildlife, especially in winter storms.

ENRTF BUDGET: $99,986

Outcome	Completion Date
1. Deployment of living snow fences in the field.	Oct. 31, 2022
2. Field investigation of snow drift control in winter storm events.	March 31, 2023
3. Report of wildlife activities monitored around the fences.	March 31, 2023

Activity 3 Title: Publish research outcomes and outreach to Minnesota landowners for public awareness.
Description: We will build an online platform for sharing our research outcomes, including the model for fence design, data collected from experiments, and wildlife monitoring data to the state agencies, research institutes, and the public. We will reach out to Minnesota landowners through tutorials and demonstrations to assimilate the idea of wildlife preservation in winter.

ENRTF BUDGET: $29,996

Outcome	Completion Date
1. An online platform for data publication.	June 30, 2022
2. Tutorials and demonstrations to the public.	June 30, 2023

III. PROJECT PARTNERS AND COLLABORATORS:

IV. LONG-TERM IMPLEMENTATION AND FUNDING:

This project is scheduled to be completed within three years in accordance with the activities and completion dates listed above, but the ecological benefits to Minnesota will be long-term. Once the optimized living snow fence design is obtained, it can be used for many years. Meanwhile, new designs can continue to be made using the design approach developed in this project. Extended monitoring of wildlife activities is optional for understanding the effect of living snow fences in the long run. One of the main goals of this project is to invoke the wildlife protection awareness of Minnesotans, and the work proposed here is one of many possible solutions for Minnesota landowners. We expect that more Minnesotans will be inspired by our work.

V. SEE ADDITIONAL PROPOSAL COMPONENTS:

A. Proposal Budget Spreadsheet
B. Visual Component or Map
F. Project Manager Qualifications and Organization Description

Attachment A: Project Budget Spreadsheet
Environment and Natural Resources Trust Fund
M.L. 2020 Budget Spreadsheet
Legal Citation:
Project Manager: Lian Shen
Project Title: Control of Snowdrift Using Living Fences to Protect Wildlife
Organization: Regents of the University of Minnesota
Project Budget: $199,971
Project Length and Completion Date: 3 years; June 30, 2023
Today's Date: April 12, 2019

ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET	Budget	Amount Spent	Balance
BUDGET ITEM			
Personnel (Wages and Benefits)	$ 188,271	$ -	$ 188,271
Lian Shen, Program Manager (74% salary, 26% benefits); 3.7% FTE, 0.5 month per year. ($34,656)			
Postdoctoral Associate, experiment and modeling research (80% salary, 20% benefit); 50% FTE for each of 3 years. ($96,048)			
Graduate student, modeling study (84% salary, 16% benefit); 3 summers month per year for 3 years. ($20,892)			
Undergraduate Assistant, measurement study (100% salary); 1.5 months for each of 3 years. ($7,200)			
Engineer, device design and data analysis (85% salary, 15% benefit); 15% FTE for each of 3 years. ($26,113)			
Professional/Technical/Service Contracts			
	$ -	$ -	$ -
Equipment/Tools/Supplies			
The supplies and equipment for the field and laboratory experiment will include: laser scanner for snow drift measurements in the laboratory ($3,000) and the operation and maintenance costs of the SAFL wind tunnel ($1,000), snow and plant models in wind tunnel ($1,500), material for outdoor deployment and demonstration ($2,000), camera and anchoring system for monitoring the field experiments ($3,000).	$ 10,500	$ -	$ 10,500
Capital Expenditures Over $5,000			
	$ -	$ -	$ -
Fee Title Acquisition			
	$ -	$ -	$ -
Easement Acquisition			
	$ -	$ -	$ -
Professional Services for Acquisition			
	$ -	$ -	$ -
Printing			
	$ -	$ -	$ -
Travel expenses in Minnesota			
Tranportation within Minnesota state for field data collection, field demonstation, and research meetings in the state. Estimation of cost for 3 years: Mileage $0.58/mile x 1000 miles =$580; Incidental expense during travel $120; Lodging $500.	$ 1,200	$ -	$ 1,200
Other			
	$ -	$ -	$ -
COLUMN TOTAL	$ 199,971	$ -	$ 199,971

SOURCE AND USE OF OTHER FUNDS CONTRIBUTED TO THE PROJECT	Status (secured or pending)	Budget	Spent	Balance
Non-State:		$ -	$ -	$ -
State:		$ -	$ -	$ -
In kind: The University of Minnesota does not charge the State of Minnesota its typical overhead rate of 54% of the total modified direct costs.		$ 107,984	$ -	$ 107,984

Other ENRTF APPROPRIATIONS AWARDED IN THE LAST SIX YEARS	Amount legally obligated but not yet spent	Budget	Spent	Balance
		$ -	$ -	$ -

Control Snowdrift Using Living Fences to Protect Wildlife

Motivation

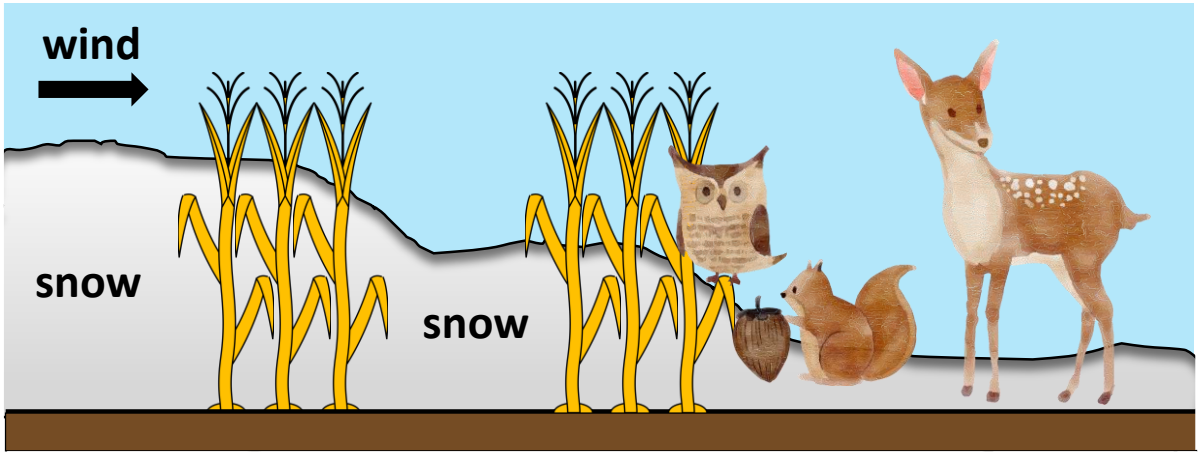
Loss of plants destroys shelters against snowdrift

Snowdrift can bury unprotected wildlife and livestock

Thick snow also makes foraging harder

Plan

Low-cost living snow fences can provide shelters against snowdrift



Optimize living snow fence design for maximized ecology benefits under the limitation of economical cost

PROJECT MANAGER QUALIFICATIONS

This project will be led by Professor Lian Shen as program manager. Prof. Shen is the Director of the St. Anthony Falls Laboratory and a Professor in the Department of Mechanical Engineering at University of Minnesota, Twin Cities. He earned his Doctor of Science degree from Massachusetts Institute of Technology (MIT) in 2001. After three years of postdoctoral training at MIT, he joined the faculty of Johns Hopkins University (JHU) in 2004. At JHU, he performed extensive research on environmental water and air flows. In 2012, he was recruited by University of Minnesota to join its faculty.

Prof. Shen is a world expert on the study of environmental fluid flows. He is currently serving on the national committee of ASCE Environmental & Water Resources Institute on CFD Applications in Water and Wastewater Treatment. He is also on the editorial boards of three internal academic journals. Prof. Shen has been active in professional societies, including American Geophysical Union, American Society of Civil Engineers, American Society of Mechanical Engineers, and Association of Environmental Engineering and Science Professors. He has organized several national and international conferences and symposiums.

ORGANIZATION DESCRIPTION

This project will be performed at the St. Anthony Falls Laboratory (SAFL, http://www.safl.umn.edu) at University of Minnesota. SAFL is an interdisciplinary fluid mechanics research and educational institution. It has 22 faculty members and 35 research and administrative staff members. SAFL is a world-renowned research laboratory specialized in environmental and engineering fluid mechanics. SAFL researchers have been performing many innovative environmental studies for the state of Minnesota. Some of the projects were/are funded by the Minnesota Environment and Natural Resources Trust Fund.

The proposed research leverages on the advanced capability of measuring environmental flows at SAFL, which has 16,000 ft^2 of research space dedicated to physical modeling and experimentation. The facility, which has recently been upgraded with a $16M renovation, has a wind tunnel and 15 general purpose flumes, tanks, and channels readily configurable to the needs of projects. SAFL field research is as broad as its laboratory work and includes establishing long-term monitoring sites as well as developing new methods and techniques for observing, measuring, logging, and communicating environmental processes. SAFL has tremendous experience in developing a field approach for a range of applications, such as remoting measurement of atmospheric and aquatic fluid flows and temperature.

The powerful cluster computers equipped at SAFL support the numerical modelling in the proposed research. Driven by the exponential growth of computational power, scientific computing is now radically transforming our research philosophy by enabling the simulation of many complex flow phenomena across a broad range of scales in natural and engineered systems with an unprecedented degree of realism. Coupled with the state-of-art measurement techniques and unique experimental facilities, SAFL's simulation-based expertise has uniquely positioned the laboratory to make far-reaching advances in the major societal problems in energy, the environment, and human health. SAFL has two High Performance Computing (HPC) Beowulf-style computer clusters with execution and compute nodes connected by low-latency/high-throughput local interconnects (InfiniBand).