Environment and Natural Resources Trust Fund

2021 Request for Proposal

General Information

Proposal ID: 2021-457

Proposal Title: Do Beavers Buffer Against Droughts and Floods?

Project Manager Information

Name: Steve Windels

Organization: National Park Service - Voyageurs National Park

Office Telephone: (218) 283-6692

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Project Basic Information

Project Summary: We propose to use existing data sets to link beaver population data to water storage in beaver ponds, to determine if they buffer against droughts and floods.

Funds Requested: $169,000

Proposed Project Completion: 2023-12-31

LCCMR Funding Category: Small Projects (H)

Secondary Category: Foundational Natural Resource Data and Information (A)

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.

Beavers are called “ecosystem engineers” because their dam-building activities create ponds that store large amounts of water and sediment, altering landscapes on a scale rivaled only by humans. Predicted climate change scenarios for Minnesota suggest changes in timing and amounts of rainfall will increase the frequency of both floods and droughts. Beaver ponds provide a natural solution to mitigate these effects because beaver ponds reduce the severity of flood events and store immense amounts of water during droughts. Due to this, beaver ponds will continue to be important habitat for fish and wildlife such as moose, swans, and brook trout as Minnesota’s landscape and climate changes, proving beavers are indeed “keystone species.”

Though techniques exist to calculate how much water beavers store in ponds, we still lack understanding of where, when, and why beavers build their ponds where they do. That is, we don’t know how changes in beaver populations, at individual, colony, and population scales, affect where and when beavers build and maintain ponds. Increased knowledge in these areas will improve understanding of how changes in beaver abundance will result in changes in water storage, better informing how northern Minnesota will respond to future floods and droughts.

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

The Greater Voyageurs Ecosystem (GVE) surrounding Voyageurs National Park contains some of the highest densities of beavers in the USA, and long-term research on beavers conducted in the park has yielded unprecedented insights into beaver ecology for the benefit of natural resource managers and scientists in Minnesota and beyond. More than 65 peer-reviewed science publications have resulted from beaver-related research conducted at that park from the 1980s to the present. More importantly, park staff and collaborators have continued to collect a wealth of data from the GVE, in the process establishing one of the largest and longest running studies of beaver populations in the world. National Park Service Wildlife Biologist Dr. Steve Windels and others have successfully captured more than 1,300 individual beavers, digitized more than 7,000 beaver ponds and dams, mapped nearly 4,000 beaver lodges in the GVE, and captured more than 150,000 photographs of beavers using game cameras since 2004.

We propose to extract new and valuable additional information from this unprecedented dataset that can be used better understand how beavers affect water storage and availability, and this information will be used to improve science and management of Minnesota’s water resources.

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?

The proposed research will provide answers to the following questions about how beavers affect water storage and availability in northern Minnesota:
Question 1: How much water storage exists in the Greater Voyageurs Ecosystem and has it changed through time?
Question 2: Why do beavers build dams and lodges where they do and how can understanding this assist management?
Question 3: How does death and dispersal of beavers affect creation of new dams or re-occupancy of old ones?

Activities and Milestones

Activity 1: How much water storage exists in the Greater Voyageurs Ecosystem and has it changed through time?

Activity Budget: $41,000

Activity Description:
Previous projects have digitized beaver ponds and dams on aerial photo sets spanning the period 1927-2013 within selected areas of the GVE. Additional work is planned for 2020 to include more recent photo sets. We will apply existing algorithms to convert pond dimensions (area, dam length, mean depth) to actual and potential water storage capacity to document changes over time and space, and how these relate to periods of flood and drought conditions. We will also link changes in water storage capacity to changes in beaver populations in the GVE.

Activity Milestones:

Description	Completion Date
Estimate water storage capacity for available years	2022-06-30
Final report and peer-reviewed publication submitted	2022-12-31

Activity 2: Determine factors affecting where beavers build dams and lodges to improvement management.

Activity Budget: $51,000

Activity Description:
Where beavers decide to build dams and lodges has an influence on the size and shape of individual beaver ponds, and thus affects their water storage capacity. Using our existing database of >4,000 beaver lodges, we will build computer models to understand what factors best predict where beavers build their dams and lodges.

Activity Milestones:

Description	Completion Date
Analyze factors affecting where beavers build dams and lodges	2023-06-30
Final report and peer-reviewed publication submitted	2023-12-31

Activity 3: How does death and dispersal of beavers affect creation of new dams or re-occupancy of old ones?

Activity Budget: $77,000

Activity Description:
We will use our existing data sets of live-capture data, lodge occupancy, and digitized pond layers to investigate how death and dispersal of individual beavers from a colony can affect occupancy or abandonment of dams and ponds used by colony members. We will also estimate population rates of mortality and dispersal to link to changes in pond formation rate and water storage capacity across the larger Greater Voyageurs Ecosystem.

Activity Milestones:

Description	Completion Date

Analyze factors affecting abandonment and establishment of beaver colonies	2023-06-30
Final report and peer-reviewed publication submitted	2023-12-31

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Thomas Gable	Department of Fisheries, Wildlife, and Conservation Biology, University of Minnesota	Assistance with study design and writing.	No
Sean Johnson-Bice	University of Manitoba	Assistance with study design and writing.	No
Dr. Jake Ferguson	University of Hawaii	Assistance with study design, analysis, and writing.	No
Dr. Joseph Bump	Department of Fisheries, Wildlife, and Conservation Biology, University of Minnesota	Assistance with study design and writing.	No

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 be funded?

This project builds on an existing long-term database of beaver data unparalleled in North America, conservatively representing >$2,000,000 in previous funding. This project also builds on the 2017 LCCMR project "Effects of Wolves on Beavers, Moose, and Deer in the Border Lakes Region." We will disseminate our information through peer-reviewed publications and reports, print/social media, and public presentations to ensure knowledge transfer.

Other ENRTF Appropriations Awarded in the Last Six Years

Name	Appropriation	Amount Awarded
Evaluate Control Methods for Invasive Hybrid Cattails	M.L. 2018, Chp. 214, Art. 4, Sec. 2, Subd. 06c	$131,000
Effects of Wolf Predation on Beaver, Moose, and Deer	M.L. 2017, Chp. 96, Sec. 2, Subd. 03l	$293,000

Project Manager and Organization Qualifications

Project Manager Name: Steve Windels

Job Title: Wildlife Biologist

Provide description of the project manager's qualifications to manage the proposed project.

Dr. Steve K. Windels has been a Research Wildlife Biologist at Voyageurs National Park, MN from 2003-present. He currently oversees research and monitoring projects on beavers, wolves, moose, and other wildlife species. Dr. Windels has developed an international reputation as an expert in beaver and wetland ecology, resulting in 18 publications in peer-reviewed journals, 1 book chapter, 4 completed MS theses, and dozens of presentations at local and national conferences from beaver-related data collected at VNP. Relevant to the proposed project, he and his staff have successfully live-trapped and marked more than 1,200 individual beavers, mapped nearly 4,000 beaver lodges in the

park and surrounding landscape, and captured more than 150,000 photographs of beavers using game cameras since 2004. He won the prestigious National Park Service Director's Award for Natural Resource Research in 2014. He is Adjunct Assistant Professor in the Department of Fisheries, Wildlife, and Conservation Biology at the University of Minnesota.

Dr. Windels has successfully managed many projects of similar or larger size during his 18 yr tenure with the National Park Service, including 2 past/current LCCMR-funded projects.

Education/Certification
Ph.D. in Wildlife Ecology, Michigan Technological University
M.S. in Range and Wildlife Management, Texas A&M University – Kingsville
B.S. in Fisheries and Wildlife Management, University of Minnesota
Certified Wildlife Biologist® by The Wildlife Society.

Organization: National Park Service - Voyageurs National Park

Organization Description:
The mission of the National Park Service, celebrating its 100th Anniversary in 2016, is "to preserve unimpaired the natural and cultural resources and values of the National Park System for the enjoyment, education, and inspiration of this and future generations." Voyageurs National Park, Minnesota's only National Park, was established in 1975 to preserve the history and natural resources of the Border Lakes Region. In many ways, beavers are to Voyageurs National Park as wolves are to Yellowstone National Park, or wildebeest are to the Serengeti. They are an iconic wildlife species whose activity shapes both the ecological foundations of the park but also the experience of we humans who visit it. Voyageurs National Park presents a unique window into the past about the dramatic importance of beavers to shaping their environment, perhaps only on a scale equaled by humans. The National Park Service has a strong mission to promote the use of National Parks as natural laboratories to better understand the natural world.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	$ Amount
Personnel								
Term Wildlife Biologist		Will implement analysis and serve as lead author for publications and reports.			33%	2		$160,000
							Sub Total	**$160,000**
Contracts and Services								
							Sub Total	**-**
Equipment, Tools, and Supplies								
	Tools and Supplies	Computer software, licensing, office supplies	To aid in completion of analyzing existing data or compiling new data for analyses.					$3,000
							Sub Total	**$3,000**
Capital Expenditures								
							Sub Total	**-**
Acquisitions and Stewardship								
							Sub Total	**-**
Travel In Minnesota								
	Conference Registration Miles/ Meals/ Lodging	Miles/ Meals/ Lodging associated with travel	Presentation of project results					$3,000
							Sub Total	**$3,000**

Travel Outside Minnesota								
							Sub Total	**-**
Printing and Publication								
							Sub Total	**-**
Other Expenses								
		Page charges for peer-reviewed publications (3@ $1000/ea)	Fees needed to publish results in peer-reviewed journals					$3,000
							Sub Total	**$3,000**
							Grand Total	**$169,000**

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				
In-Kind	US National Park Service	Voyageurs National Park: Wildlife Biologist - 20% FTE salary/benefits for 2.5 yrs for project management, analysis, and writing ($61,000); GIS Specialist 10% FTE salary/benefits for 2.5 yrs GIS support ($24,000); use of office space, computers, software, etc. ($5,000); Seasonal technician - 25% FTE salary/benefits for 2.0 years for data entry and management ($20,000).	Pending	$110,000
			Non State Sub Total	**$110,000**
			Funds Total	**$110,000**

Attachments

Required Attachments

Visual Component

File: 98b617fe-925.pdf

Alternate Text for Visual Component

Minnesota's climate is changing. Precipitation events are becoming flashier and heavier; summer droughts more intense. How do we keep the "right" amount of water on the landscape?

Beavers are ecosystem engineers, creating ponds by damming small streams. Each individual pond can hold as much as 2 million gallons of water. They also provide habitat for many wetland wildlife species.

At larger scales, beavers can dramatically increase the water-storage capacity of the landscape in relatively short time frames!

BUT WE STILL DON'T UNDERSTAND WHY BEAVER POPULATIONS CHANGE, HOW POPULATION CHANGES ARE LINKED TO CLIMATE AND WEATHER EVENTS, AND WHAT THAT MEANS FOR WATER STORAGE!

Optional Attachments

Support Letter or Other

Title	File
Windels Qualifications	909be194-f9a.pdf

Administrative Use

Does your project include restoration or acquisition of land rights?

No

Does your project have patent, royalties, or revenue potential?

No

Does your project include research?

Yes

Does the organization have a fiscal agent for this project?

No

Do Beavers Buffer Against Droughts and Floods?

Steve Windels

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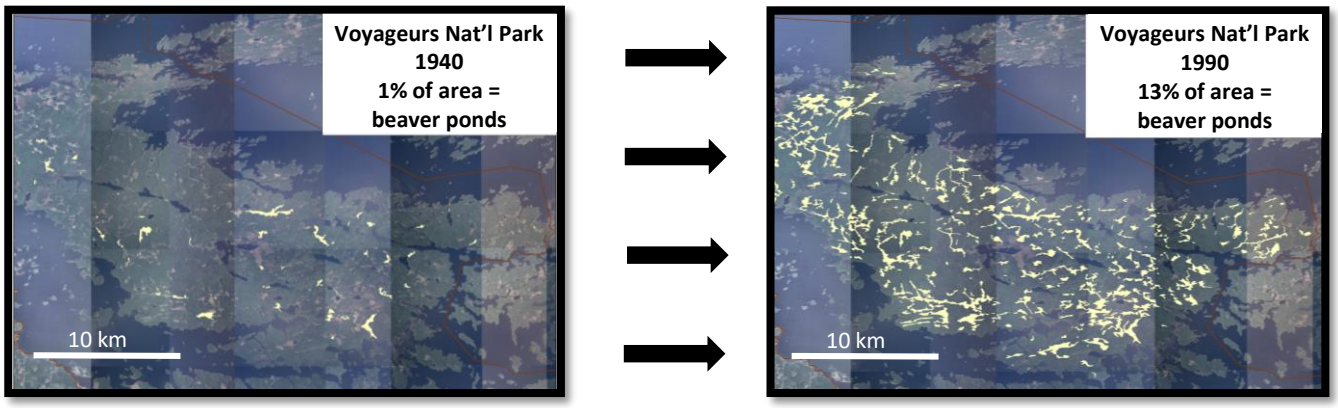

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Voyageurs National Park (VNP) is a *natural laboratory* to study beavers.

- Highest beaver densities recorded in the United States.
- Currently, VNP operates largest and longest-running beaver study in North America.
- Combines aerial surveys, live-capture data, and air photo interpretation to monitor beaver population dynamics and landscape change.




Expected Project Outcomes

- Link beaver population dynamics to changes in water storage capacity.
- Estimates of water storage of beaver ponds over time.
- Improved beaver management to meet local and regional planning needs.