

Final Abstract

Final Report Approved on January 29, 2025

M.L. 2020 Project Abstract

For the Period Ending June 30, 2024

Project Title: Do Beavers Buffer Against Droughts And Floods?

Project Manager: Steve Windels

Affiliation: National Park Service - Voyageurs National Park

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Funding Source:

Fiscal Year:

Legal Citation: M.L. 2021, First Special Session, Chp. 6, Art. 5, Sec. 2, Subd. 03I

Appropriation Amount: \$168,000

Amount Spent: -

Amount Remaining: \$168,000

Sound bite of Project Outcomes and Results

The project was not completed due to inadequate staffing and other personnel reasons. No LCCMR-appropriated funding was expended, and all funds were returned. The need for the goals and objectives outlined for the project remains, and Voyageurs National Park will continue to pursue these goals through its resource management programs.

Overall Project Outcome and Results

The project was not completed due to inadequate staffing and other personnel reasons. No LCCMR-appropriated funding was expended, and all funds were returned. The need for the goals and objectives outlined for the project remains, and Voyageurs National Park will continue to pursue these goals through its resource management programs.

Project Results Use and Dissemination

The project was not completed due to inadequate staffing and other personnel reasons. Dissemination related to early project progress was limited:

Public Presentations and Media Outreach

1. Windels, S.K. Beavers and the Creation of Habitat and Biodiversity. Presentation to Midwest Beaver Summit, Virtual September 28, 2023.
2. Windels, S.K. Beavers are the answer, the question is irrelevant. West Metro Chapter of Master Naturalists, Virtual, April 2023.
3. Windels, S.K. Beavers as agents of natural forest disturbance. Natural Disturbance Forest Habitat Summit, UMN Cloquet
4. Great Lakes Now, PBS-Detroit. Beavers, Biodiversity and Climate Resilience in the Great Lakes.



Environment and Natural Resources Trust Fund

M.L. 2020 Approved Final Report

General Information

Date: January 29, 2025

ID Number: 2020-016

Staff Lead: Michael Varien

Project Title: Do Beavers Buffer Against Droughts And Floods?

Project Budget: \$168,000

Project Manager Information

Name: Steve Windels

Organization: National Park Service - Voyageurs National Park

Office Telephone: (218) 283-6692

Email: steve_windels@nps.gov

Web Address: <https://www.nps.gov/voya/index.htm>

Project Reporting

Final Report Approved: January 29, 2025

Reporting Status: Project Completed

Date of Last Action: January 29, 2025

Project Completion: June 30, 2024

Legal Information

Legal Citation: M.L. 2021, First Special Session, Chp. 6, Art. 5, Sec. 2, Subd. 03I

Appropriation Language: \$168,000 the second year is from the trust fund to the commissioner of natural resources for an agreement with Voyageurs National Park to analyze existing data sets to determine the role of beaver populations and beaver ponds in buffering the region against droughts and floods.

Appropriation End Date: June 30, 2025

Narrative

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.

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 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? Introduce us to the work you are seeking funding to do. You will be asked to expand on this proposed solution in Activities & Milestones.

Voyageurs National Park (VNP) and the surrounding ecosystem 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 VNP area, 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 VNP area, 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 Voyageurs National Park area 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?

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

Activities and Milestones

Activity 1: How much water storage exists in the Voyageurs National Park area 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 VNP area. 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 VNP area.

Activity Milestones:

Description	Approximate Completion Date
Estimate water storage capacity for available years	June 30, 2023
Final report and peer-reviewed publication submitted	December 31, 2023

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	Approximate Completion Date
Analyze factors affecting where beavers build dams and lodges	December 31, 2023
Final report and peer-reviewed publication submitted	June 30, 2024

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

Activity Budget: \$76,000

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 Voyageurs National Park area.

Activity Milestones:

Description	Approximate Completion Date
Analyze factors affecting abandonment and establishment of beaver colonies	December 31, 2023

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Dr. Jerry Belant	Michigan State University	Assistance with study design, analysis, and writing. Supervision of post-doctoral researcher.	Yes
Dr. Seth Moore	Grand Portage Reservation Tribal Government	Assistance with study design and writing. As of 4/7/22, the project manager confirms that Dr. Seth Moore is not deriving any direct personal financial benefit from this project.	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.

Project progress and results will be shared with the public in a number of ways. While analyses are proceeding, outreach will include newsletter articles; articles in local, regional, and state newspapers; posts on Voyageurs National Park's Facebook page and Instagram page; presentations to interested stakeholder groups (e.g., Voyageurs National Park Association or International Joint Commission); presentations at scientific conferences; and peer-reviewed literature in quality journals. 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?

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 for Windels/Voyageurs National Park "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
Effects of Wolf Predation on Beaver, Moose, and Deer	M.L. 2017, Chp. 96, Sec. 2, Subd. 03l	\$293,000
Evaluate Control Methods for Invasive Hybrid Cattails	M.L. 2018, Chp. 214, Art. 4, Sec. 2, Subd. 06c	\$131,000

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	\$ Amount	\$ Amount Spent	\$ Amount Remaining
Personnel										
							Sub Total	-	-	-
Contracts and Services										
Michigan State University	Sub award	A post-doctoral research associate will be hired to coordinate data analysis and serve as lead or co-author on publication and reports resulting from this project. Grand Portage Indian Reservation Tribal Government can no longer be contracted to hire the post-doctoral researcher, so Michigan State will be contracted instead.				2		\$160,000	-	\$160,000
							Sub Total	\$160,000	-	\$160,000
Equipment, Tools, and Supplies										
	Tools and Supplies	lab supplies	To aid in completion of analyzing existing data or compiling new data for analyses.					\$3,000	-	\$3,000
							Sub Total	\$3,000	-	\$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	-	\$3,000
							Sub Total	\$3,000	-	\$3,000
Travel Outside Minnesota										
							Sub Total	-	-	-
Printing and Publication										
	Publication	Page charges for peer-reviewed publications (2@\$1000/ea)	Page charges for peer- reviewed publications (2@\$1000/ea)					\$2,000	-	\$2,000
							Sub Total	\$2,000	-	\$2,000
Other Expenses										
							Sub Total	-	-	-
							Grand Total	\$168,000	-	\$168,000

Classified Staff or Generally Ineligible Expenses

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

Category	Specific Source	Use	Status	\$ Amount	\$ Amount Spent	\$ Amount Remaining
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	-	\$110,000
In-Kind	Michigan State University	\$50,000 salary/comp for Jerry Belant's time \$25,000 waived overhead	Pending	\$75,000	-	\$75,000
			Non State Sub Total	\$185,000	-	\$185,000
			Funds Total	\$185,000	-	\$185,000

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 s...

Supplemental Attachments

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

Title	File
Windels Qualifications	909be194-f9a.pdf
AUthorization letter	c4ec0868-0bb.doc
Background Form	4d6acc29-873.pdf

Difference between Proposal and Work Plan

Describe changes from Proposal to Work Plan Stage

Budget fixed to reflect \$168,000 recommended.

Changed project collaborators to reflect new collaborators.

Changed timelines and due dates to reflect new project start date and anticipated extra require to complete (from 2.5 to 3.0yrs).

Additional Acknowledgements and Conditions:

The following are acknowledgements and conditions beyond those already included in the above workplan:

Do you understand and acknowledge the ENRTF repayment requirements if the use of capital equipment changes?

N/A

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 Commissioner's Plan 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?

Yes

Does the organization have a fiscal agent for this project?

No

Work Plan Amendments

Amendment ID	Request Type	Changes made on the following pages	Explanation & justification for Amendment Request (word limit 75)	Date Submitted	Approved	Date of LCCMR Action
1	Amendment Request	<ul style="list-style-type: none"> • Narrative • Project Collaborators - Project Partner Info • Activities and Milestones • Budget - Professional / Technical Contracts • Budget - Non-ENRTF Funds Contributed 	<p>Seth Moore needed to recuse himself/Grand Portage from the funded portion of this project due to his role on the LCCMR committee. The other Project Partner, Jerry Belant, now works at Michigan State University, which will now be contracted to hire the post-doc instead of GP.</p> <p>Sean Johnson-Bice and Jake Ferguson removed themselves as Project Partners.</p> <p>The terms Greater Voyageurs Ecosystem/GVE have been replaced with Voyageurs National Park area, the more appropriate term.</p>	May 5, 2022	Yes	May 9, 2022

Status Update Reporting

Final Status Update August 14, 2024

Date Submitted: January 14, 2025

Date Approved: January 21, 2025

Overall Update

The project was not completed due to inadequate staffing and other personnel reasons. No LCCMR-appropriated funding was expended, and all funds were returned. The need for the goals and objectives outlined for the project remains, and Voyageurs National Park will continue to pursue these goals through its resource management programs.

Activity 1

Activity 1 was not completed and no LCCMR-appropriated funding was expended towards this activity. All funds were returned. Early progress was limited to compiling and proofing available digitized pond datasets that were to be used in Activity 1.

Activity 2

Activity 2 was not completed and no LCCMR-appropriated funding was expended towards this activity. All funds were returned. Early progress was limited to completing aerial beaver surveys in 2020-2022 and updating the beaver lodge database.

Activity 3

Activity 3 was not completed and no LCCMR-appropriated funding was expended towards this activity. All funds were returned. Early progress was limited to 3 years of mark-recapture sampling of beavers in 2020-2022 and updating the beaver capture database.

Dissemination

The project was not completed due to inadequate staffing and other personnel reasons. No LCCMR-appropriated funding was expended, and all funds were returned. Dissemination related early project progress was limited:

Public presentations

1. Windels, S.K. Beavers and the Creation of Habitat and Biodiversity. Presentation to Midwest Beaver Summit, Virtual September 28, 2023.
2. Windels, S.K. Beavers are the answer, the question is irrelevant. West Metro Chapter of Master Naturalists, Virtual, April 2023.
3. Windels, S.K. Beavers as agents of natural forest disturbance. Natural Disturbance Forest Habitat Summit, UMN Cloquet Forestry Center, November, 2022.

Media outreach

1. Great Lakes Now, PBS-Detroit. Beavers, Biodiversity and Climate Resilience in the Great Lakes.
<https://www.facebook.com/greatlakesnow/videos/145046345293727>

Status Update Reporting

Status Update April 1, 2024

Date Submitted: January 14, 2025

Date Approved: January 21, 2025

Overall Update

The project has not progressed beyond what was detailed in previous status updates, and the project will not be completed. No funding was expended.

Activity 1

The project has not progressed beyond what was detailed in previous status updates, and the project will not be completed. No funding was expended.

Activity 2

The project has not progressed beyond what was detailed in previous status updates, and the project will not be completed. No funding was expended.

Activity 3

The project has not progressed beyond what was detailed in previous status updates, and the project will not be completed. No funding was expended.

Dissemination

The project has not progressed beyond what was detailed in previous status updates, and the project will not be completed. No funding was expended.

Status Update Reporting

Status Update October 1, 2023

Date Submitted: January 14, 2025

Date Approved: January 21, 2025

Overall Update

Limited progress has been made since the last update in April. Overall, the project is behind schedule for completion by the current end date and we will be seeking an extension to complete all activities.

Activity 1

Limited progress has been made on Activity 1 since the last update. We anticipate needing an extension to complete this activity.

Activity 2

Limited progress has been made on Activity 2 since the last update. We anticipate needing an extension to complete this activity.

Activity 3

Limited progress has been made on Activity 3 since the last update. We DO anticipate completion of this Activity by the current project end date as originally planned.

Dissemination

Public presentations

1. Windels, S.K. Beavers and the Creation of Habitat and Biodiversity. Presentation to Midwest Beaver Summit, Virtual September 28, 2023.

Media outreach

1. Great Lakes Now, PBS-Detroit. Beavers, Biodiversity and Climate Resilience in the Great Lakes.

<https://www.facebook.com/greatlakesnow/videos/145046345293727>

Status Update Reporting

Status Update April 1, 2023

Date Submitted: January 14, 2025

Date Approved: January 21, 2025

Overall Update

Progress has continued on the project, though again slower than anticipated due to staffing issues within the NPS and Voyageurs National Park. We are working to initiate an agreement to hire/contract additional science support that will conduct portions of the analyses.

Activity 1

We have continued to compile and proof (i.e., conduct quality control) available digitized pond datasets that will be used in Activity 1. Next steps include completing basic summary statistics of individual data sets and prepping data for initial model runs.

Activity 2

Voyageurs National Park staff have completed aerial beaver surveys in 2020-2022, and the overall beaver lodge database (now running from 1984-2022) is being updated and proofed to include all available lodge data within the park. More than 1500 additional datapoints have been added to the total lodge database for VNP.

Activity 3

In addition to aerial surveys mentioned in Activity 2, Voyageurs National Park staff have completed additional years of mark-recapture sampling of beavers in 2020-2022, resulting in an at least 225 new individual beavers into the database from 72 different lodges. These data are being added to the long-term capture database (now running from 2006-2022) and the data used in the models related to lodge occupancy and dispersal rates.

Dissemination

We completed the following outreach during the reporting period:

1. Windels, S.K. Beavers are the answer, the question is irrelevant. West Metro Chapter of Master Naturalists, Virtual, April 2023.
2. Windels, S.K. Beavers as agents of natural forest disturbance. Natural Disturbance Forest Habitat Summit, UMN Cloquet Forestry Center, November, 2022.

Status Update Reporting

Status Update October 1, 2022

Date Submitted: November 2, 2022

Date Approved: November 7, 2022

Overall Update

Progress has continued on the project, though again slower than anticipated due to staffing issues at the NPS and Voyageurs National Park, and the removal of Dr. Seth Moore as a Project Partner and Dr. Jerry Belant changing universities.

The funding mechanism to hire the post-doctoral researcher who will be completing the bulk of the analysis and writing has been identified but the process is slower than anticipated due to staffing constraints at the NPS Agreements Office. Other external funding has been identified by the NPS to help fund the post-doc until the funding agreement is in place to use the budgeted LCCMR funds.

We are on track, however, to still complete our deliverables by the approved due dates.

Activity 1

We have continued to compile and proof (i.e, conduct quality control) available datasets that will be used in this activity. We are slightly behind schedule in this task for the reasons stated in the overall update above, however, we still expect to be on track to meet activity deliverables on time.

Activity 2

We have continued to compile and proof (i.e, conduct quality control) available datasets that will be used in this activity. We are slightly behind schedule in this task for the reasons stated in the overall update above, however, we still expect to be on track to meet activity deliverables on time.

Activity 3

We have continued to compile and proof (i.e, conduct quality control) available datasets that will be used in this activity. We are slightly behind schedule in this task for the reasons stated in the overall update above, however, we still expect to be on track to meet activity deliverables on time.

Dissemination

No dissemination has occurred to date, primarily because no substantive progress has been made on any of the activities to date. We do expect some outreach to occur before the next project update as we ramp up activities.

Status Update Reporting

Status Update April 1, 2022

Date Submitted: May 5, 2022

Date Approved: May 9, 2022

Overall Update

Progress towards completion of all project outcomes has occurred, though slightly less than we anticipated. This has primarily been a result of unexpected staffing issues at Voyageurs National Park; NPS-related delays in signing the funding agreement with the MNDNR; issues related to Project Partner Dr. Seth Moore having to recuse himself/Grand Portage from being contracted to hire the post-doc as originally proposed; and Project Partner Dr. Jerry Belant very recently changing universities from Syracuse University-New York to Michigan State University.

Staffing issues at Voyageurs National Park have now been resolved so that data management can continue, and a new funding mechanism has been identified to hire the post-doctoral researcher who will be completing the bulk of the analysis and writing.

Activity 1

Progress has begun to compile and proof (i.e, conduct quality control) available datasets that will be used in this activity. We are slightly behind schedule in this task for the reasons stated in the overall update above, however, we expect to get back on track to meet activity deliverables on time.

Activity 2

Progress has begun to compile and proof (i.e, conduct quality control) available datasets that will be used in this activity. We are slightly behind schedule in this task for the reasons stated in the overall update above, however, we expect to get back on track to meet activity deliverables on time.

Activity 3

Progress has begun to compile and proof (i.e, conduct quality control) available datasets that will be used in this activity. We are slightly behind schedule in this task for the reasons stated in the overall update above, however, we expect to get back on track to meet activity deliverables on time.

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