

**Environment and Natural Resources Trust Fund
2016 Request for Proposals (RFP)**

Project Title:

ENRTF ID: 016-A

Improving Brook Trout Stream Habitat through Beaver Management

Category: A. Foundational Natural Resource Data and Information

Total Project Budget: \$ 225,210

Proposed Project Time Period for the Funding Requested: 3 years, July 2016 to June 2019

Summary:

This project will quantify how beaver activity influences habitat quality for stream dwelling brook trout in NE MN to help improve current and future management in the region.

Name: Andrew Hafs

Sponsoring Organization: Bemidji State University

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Location

Region: NE

County Name: Cook, Lake, St. Louis

City / Township:

Alternate Text for Visual:

Map of study region and pictures of beaver management (beaver dam removal)

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



PROJECT TITLE: Improving Native Brook Trout Stream Habitat through Beaver Management

I. PROJECT STATEMENT

Northeast Minnesota (NE MN) contains more than 1,500 miles of Designated Trout Streams (Fig. 1) and trout fishing is an important recreational and economic activity in the state. Beaver control is part of the DNR's management of several trout streams in NE MN (Fig. 2). There is a need to REFINED this tool to ensure that beaver management is only applied where it HELPS trout and does not HURT trout. In cases where beaver removal hurts brook trout populations, this is a LOSE-LOSE situation for Minnesotans, because we also lose wildlife habitat creation, water filtration, recreational trapping opportunities, climate change mitigation, and other positive benefits of beavers.

Goal 1: Quantify how beaver activity influences habitat quality for stream dwelling brook trout in NE MN.

Often removing beaver from trout streams is related to the assumption that beaver activities degrade habitats by warming water temperatures beyond suitable ranges for trout. In addition to temperature, beaver dams also alter other important habitat characteristics for stream trout such as water flow and depth, sediment transport, erosion and connectivity of important seasonal habitat reaches. This project will quantify how beaver activity influences the amount of suitable brook trout habitat available in NE MN streams.

Goal 2: Quantify importance of beaver in streams to ecosystems and to trout management.

Beaver populations fluctuate over time and space and the need to manage beaver in individual trout streams will differ for different parts of the state or at different periods of time. Beaver activities, such as creation of ponds and dams along with tree cutting, are easily visible on aerial photos. Aerial photos from different time periods can show changes in the distribution and abundance of beavers. Understanding historical and current beaver population levels will provide insight into landscape-level effects and ecosystem services provided by beaver, which will be critical for wildlife diversity conservation in the face of projected climate change. In particular, beaver activities create critical habitat for waterfowl, moose, frogs, and other wetland wildlife.

Removing beaver from trout streams can lead to increased brook trout populations.

Yet maintaining beaver as a component of streams can provide benefits to stream and riparian habitat.

Optimizing brook trout management and ecological health is the outcome of this proposed research.

Brook trout streams in northeastern Minnesota are mostly fed by surface waters and are sensitive to increasing summer temperatures projected in Minnesota. The effects of beaver dams on streams could magnify temperature-related changes expected over the next 50-100 years. However, increased pool habitat resulting from beaver dams could store water and maintain flows if precipitation decreases or becomes more variable. A comprehensive analysis of the ecological cost-benefit dynamics of beaver management for improvement of brook trout habitat would benefit fisheries managers and natural resource agencies.

Results for this project will provide new information allowing for improved ability to meet management objectives for brook trout while retaining the broader ecological benefits of beaver.

II. PROJECT ACTIVITIES AND OUTCOMES

Activity 1: Effects of beaver ponds on brook trout habitat characteristics **Budget: \$128,710**

We will measure habitat characteristics (e.g., water temperature, flow, depth, dissolved oxygen, other variables) in stream reaches with matched watershed size that have varying levels of beaver activity. Estimates of suitable brook trout habitat per unit area of stream will be estimated and used to compare how brook trout habitat is influenced on average by beaver activity in NE MN. MNDNR currently conducts beaver dam removal in selected streams which will help provide varying levels of beaver activity for study site selection.



Outcome	Completion Date
1. Habitat characteristics measured in trout streams	8/31/2018
2. Provide management recommendations for beaver removal in brook trout streams	6/30/2019

Activity 2: Determine ecological effect of distribution and abundance of beaver in NE MN Trout Streams at the landscape scale

Budget: \$96,500

We will compile existing data on beaver abundance and activity for northeastern Minnesota from approximately 1900-present. We will map beaver activity in selected areas in St. Louis, Lake, and Cook counties using aerial photos from 1930s to the present to characterize changes in beaver populations over time in areas surrounding Designated Trout Streams in NE MN. We will then estimate ecological and economic costs and benefits of different management options to develop new management recommendations.

Outcome	Completion Date
1. Report summarizing current and historical patterns of beaver activity in selected watersheds with trout streams	6/30/2018
2. Management recommendations from landscape analysis of beaver populations in NE MN	6/30/2019

III. PROJECT STRATEGY

A. Project Team/Partners

Dr. Andrew Hafs, trout ecology expert with Bemidji State University (will mentor 1 graduate student).

Dr. Steve Windels, beaver ecology expert and adjunct faculty at University of Minnesota-Duluth (will mentor 1 graduate student). Dr. Windels' work on this project would be outside the scope, duties, and function of his current position with the National Park Service and would be completed on his own time.

Dr. Lucinda Johnson, cold water fish habitat and climate change expert with UMD.

MNDNR staff from Area Fisheries Offices (Deserae Hendrickson and Dean Paron), Fisheries Research (Peter Jacobsen), Wildlife Research (John Erb), and Stream Habitat Coordinator (Brian Nerbonne) will provide access to data and input during all phases of the project.

B. Project Impact and Long-Term Strategy

This project will develop management recommendations that will optimize both stream dwelling brook trout and beaver populations and the associated ecological services they provide under current and future climate scenarios. Future funding is needed to evaluate how management actions affect individual movements, survival, and population growth of trout and beaver using radio tags and other techniques.

C. Timeline Requirements

This project will require 3 years to complete, starting on 7/1/2016 and ending on 6/30/2019. We will begin collecting data in 2016 and measure habitat at study locations each year of the project.

2016 Detailed Project Budget

Project Title: Improving Native Brook Trout Stream Habitat Through Beaver Management

IV. TOTAL ENRTF REQUEST BUDGET 3 years

<u>BUDGET ITEM</u>	<u>AMOUNT</u>
Personnel:	
Hafs PI; analyze, write, manage, outreach; 10% fte; 81% salary/19% fringe, 36 mo (\$10,750)	\$ 90,350
GRA: Data collection, analysis, writing; 100% fte; 90% salary/10% fringe, 36 mo (\$52,800)	
GRA: Tuition and fees (\$11,800)	
Undergrad RA: 100% fte/3 summers; 90% salary/10% fringe (\$15,000)	
Contracts:	\$ 96,500
University of Minnesota-Duluth	
Windels Goal 2 Lead: analyze, write, manage grad student, outreach (In-Kind)	
AdvGRA; Data collect, analysis, writing; 5% fte-9 mo; 5% fte SUM 1-mo; 79% salary/21% fringe (\$9,000)	
GRA: Data collection, analysis, writing; 25% fte; 55% salary/45% fringe, 36 mo (\$39,000)	
Undergrad RA: 35% fte-18 mo, 75% fte/6 mo-SUM; 100% salary/0% fringe (\$20,000)	
GIS tech; 10% fte; 92% salary/8% fringe, 36 mo (\$9,500)	
Equipment/Supplies: GIS workstation and aerial imagery (\$15,000)	
Services - GIS lab fee (~488 hrs @ 4.10 per hour = \$2,000)	
Travel (field travel, 2 yrs, miles, food, lodging (\$2,000)	
Equipment/Tools/Supplies:	
72 Temperature loggers @ \$130 apiece	\$ 9,360
24 Depth/temperature loggers @ \$500 apiece	\$ 12,000
Flow meter	\$ 5,000
Travel:	
Field travel to/from study sites, 3 yrs, miles, food, lodging	\$ 12,000
Additional Budget Items:	
TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND \$ REQUEST =	\$ 225,210

V. OTHER FUNDS

<u>SOURCE OF FUNDS</u>	<u>AMOUNT</u>	<u>Status</u>
Other Non-State \$ Being Applied to Project During Project Period:	-	
Other State \$ Being Applied to Project During Project Period:	-	
In-kind Services During Project Period:	-	
Bemidji State University will provide indirect costs (30.7%) as in-kind match	\$ 69,139	Available
Dr. Andrew Hafs will provide access to backpack electrofishing equipment, additional YSI meters, temperature loggers, flow meters, and canoes.	\$ 15,500	Available
Dr. Steve Windels will conduct this work on his personal time (valued at \$60/hr @ 500 hours).	\$ 30,000	Available
MN DNR Fisheries spends approximately \$11,000 annually on beaver dam removal.	\$ 33,000	Available
MN DNR staff time (~\$50/hr salary/comp*100 hours) to provide access to data (temperture, flow, other habitat data) and input in project scope, development, and final projects as requested	\$ 5,000	Available
Remaining \$ from Current ENRTF Appropriation (if applicable):	-	
Funding History: Main personnel have done preliminary work on this project topic but it has not been previously funded	-	



Environment and Natural Resources Trust Fund (ENRTF)
2016 Main Proposal
Project Title: Improving Native Brook Trout Stream Habitat through Beaver Management

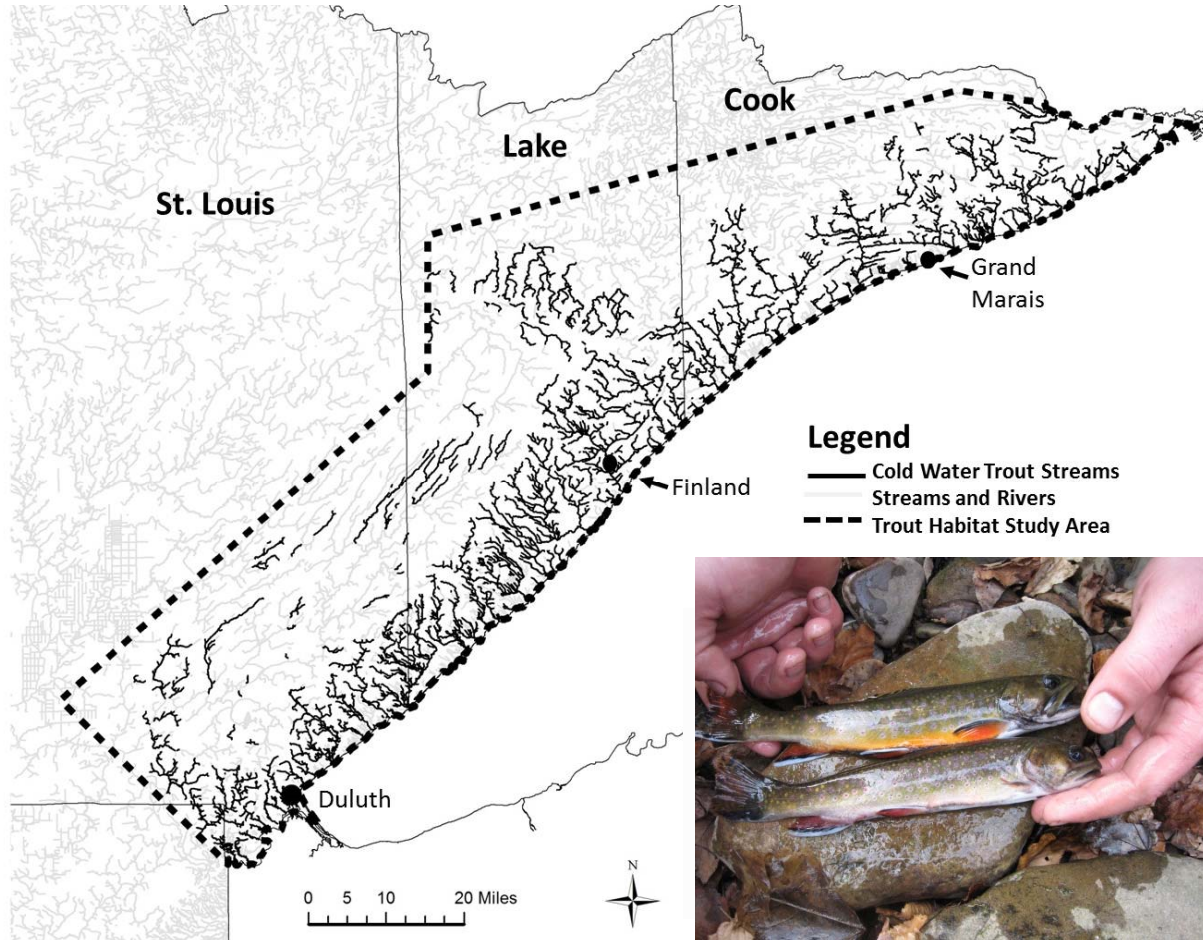


Figure 1. Location of cold water trout streams (Designated Trout Streams) where the effects of beavers on brook trout habitat will be studied.



Figure 2. Photo of a beaver dam that was recently removed from a NE MN brook trout stream (left). Also included are photos of a beaver (center) and a stream reach in which beaver activity is limited (right).



ANDREW W. HAFS

Key Qualifications

Dr. Andrew W. Hafs is a tenure track assistant professor of aquatic biology at Bemidji State University specializing in fisheries research. The Aquatic Biology Program at Bemidji State University has a strong reputation and offers MS degrees making it an excellent location to conduct research focused on stream ecology.

Ph.D., Fisheries and Wildlife Resources, West Virginia University, 2011

Dissertation Title: Bioelectrical Impedance Analysis Methods for Prediction of Brook Trout *Salvelinus fontinalis* Percent Dry Weight

Advisor: Kyle J. Hartman

M.S., Fisheries and Wildlife Science, Arkansas Tech University, 2007

Thesis Title: Smallmouth Bass Survival, Movement, and Habitat Use in Response to Seasonally Discontinuous Surface Flow.

Advisor: Charles J. Gagen

B.S., Double major in Water Resources and Biology, University of Wisconsin at Stevens Point, 2005

Advisor: Michael J. Hansen

Postdoctoral Research 2012

University of California - Santa Barbara

Bren School of Environmental Science and Management

My objectives for this project were to develop, validate, and field test, a bioenergetics model for drift feeding juvenile Chinook salmon that is combined with a hydrodynamic model established for a restored section of the Merced River, CA. This allowed us to assess and quantify the influence of habitat alteration and flow regime on juvenile salmon growth.

Supervisor: Thomas Dunne

REFEREED PUBLICATIONS

Hafs, A. W., and K. J. Hartman. 2015. Temperature corrections for bioelectrical impedance analysis models developed for age-0 and adult brook trout. *Journal of Fish Biology* 86:304-316.

Hafs, A. W., and K. J. Hartman. 2014. Developing bioelectrical impedance analysis methods for age-0 brook trout. *Fisheries Management and Ecology* 21:366-373.

Hafs, A. W., L. R. Harrison, R. M. Utz, and T. Dunne. 2014. Quantifying the role of woody debris in providing bioenergetically favorable habitat for juvenile salmon. *Ecological Modelling* 285:30-38.

Hafs, A. W., P.M. Mazik, P.B. Kenney, and J.T. Silverstein. 2012. Impact of carbon dioxide level, water velocity, strain, and feeding regimen on growth and fillet attributes of cultured rainbow trout (*Oncorhynchus mykiss*). *Aquaculture* 350-353:46-53.

Hafs, A. W., and K. J. Hartman. 2011. Influence of electrode type and location upon bioelectrical impedance analysis measurements of brook trout. *Transactions of the American Fisheries Society* 140:1290-1297.

Hafs, A. W., J. M. Niles, and K. J. Hartman. 2011. Efficiency of gastric lavage on age-0 brook trout and the influence on growth and survival. *North American Journal of Fisheries Management* 31:530-534.

Hafs, A. W., C. J. Gagen, and J. K. Whalen. 2010. Smallmouth bass summer habitat use, movement, and survival in response to low flow in the Illinois Bayou, Arkansas. *North American Journal of Fisheries Management* 30:604-612.