



Environment and Natural Resources Trust Fund (ENRTF)

M.L. 2018 ENRTF Work Plan (Main Document)

Today's Date: 2/22/18

Date of Next Status Update Report: January 31, 2019

Date of Work Plan Approval: 06/05/2018

Project Completion Date: June 30, 2021

Does this submission include an amendment request? No

PROJECT TITLE: Determining Risk of Toxic Alga in Minnesota Lakes

Project Manager: Adam J. Heathcote

Organization: Science Museum of Minnesota

College/Department/Division: St. Croix Watershed Research Station

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Location: Statewide

Total Project Budget: \$200,000

Amount Spent: \$0

Balance: \$200,000

Legal Citation: M.L. 2018, Chp. 214, Art. 4, Sec. 02, Subd. 06f

Appropriation Language: \$200,000 the second year is from the trust fund to the Science Museum of Minnesota for the St. Croix Watershed Research Station to determine the historical distribution, abundance, and toxicity of the invasive blue-green alga, *Cylindrospermopsis raciborskii*, in about 20 lakes across Minnesota and inform managers and the public about the alga's spread and health risks. This appropriation is available until June 30, 2021, by which time the project must be completed and final products delivered.

I. PROJECT STATEMENT:

Invasive microbes are easily spread, but difficult to detect, control, or reliably assess for their environmental and public health risk. Cyanobacteria (blue-green algae) are one of the most abundant and obvious microbes in lakes, and recent work suggests a shift to more toxic forms – including the invasive species, *Cylindrospermopsis raciborskii* (*Cylindro*) – with consequences including dog deaths, human illness, and reduced natural resource value. Minnesota is outside the native range of *Cylindro*, but its arrival has recently been confirmed by ENRTF supported surveys carried out by the St. Croix Watershed Research Station (SCWRS) and Minnesota Pollution Control Agency (MPCS). It is likely that recent years with warmer summer temperatures and increased nutrient pollution have provided a new niche for this species to invade.

There is little information on *Cylindro* in Minnesota and no data on the presence of toxins it produces. This information is particularly important to the State of Minnesota, because unlike other Cyanobacteria, *Cylindro* may bloom several feet below the lake surface, making it difficult to visually assess the quality and safety of waters where it is present. This project will be the first systematic survey of Minnesota for the occurrence of *Cylindro* and its cyanotoxins in Minnesota lakes – in both the water and bottom sediments. This study will determine present-day distribution and toxicity of *Cylindro*, its historic introduction and spread across the state, and develop predictive models for bloom occurrence, seasonality, toxicity, and invasion risk. These data are the critical first step in understanding and addressing the spread of any invasive species.

This project leverages current ENRTF funding for harmful algal bloom (HABs) research on the Sentinel Lakes that were selected by the DNR as a representative sample of Minnesota's lakes. It would provide an additional year of monitoring for HABs on 20 of the Sentinel Lakes during the peak bloom season and allow us to determine the historical presence of *Cylindro* through the occurrence of its toxins in those same lakes using sediment cores.

II. OVERALL PROJECT STATUS UPDATES:

First Update January 31, 2019

Second Update June 30, 2019

Third Update January 31, 2020

Fourth Update June 30, 2020

Fifth Update January 31, 2021

Final Update June 30, 2021

III. PROJECT ACTIVITIES AND OUTCOMES:

ACTIVITY 1: Survey Minnesota lakes for *Cylindro* and the conditions associated with its presence

Description: Current HABs monitoring by the St. Croix Watershed Research Station (SCWRS) will be enhanced by an additional year of monitoring on an expanded set of 20 Sentinel Lakes. SCWRS personnel will collect water quality, algae, and cyanotoxin samples during the peak bloom season (August-September) in 2018. Algae samples will be analyzed for the occurrence and abundance of *Cylindro* through standard microscopy techniques, and cyanotoxins will be measured using ELISA enzyme assays. All analyses will occur at the SCWRS CHARM Laboratory (Center for Harmful Algal Research in Minnesota). SCWRS personnel will develop a spatially

explicit predictive model for the invasive spread and bloom risk of *Cylindro* for the major Minnesota lake regions using readily available geographical, weather, and water quality data.

ENRTF BUDGET: \$72,705

Outcome	Completion Date
1. We will collect phytoplankton and water quality samples from the 20 Sentinel Lakes during peak bloom season to determine the presence and toxicity of <i>Cylindro</i>	October 2018
2. We will develop predictive criteria for the invasive spread of <i>Cylindro</i> that can be applied to Minnesota lakes based on its occurrence, abundance, and toxin production coincident with lake, water, and weather conditions	June 2021

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ACTIVITY 2: Using sediment cores to reconstruct the invasion history of *Cylindro* in Minnesota

Description: The exact timing and extent of the invasion of *Cylindro* in Minnesota is currently unknown. This activity would provide a statewide distribution and history of *Cylindro* invasion and spread using paleolimnological techniques. Sediment cores would be dated and analyzed for the toxin produced by *Cylindro*, cylindrospermopsin. Based on our sediment core analysis, the invasion history will be compared to known patterns of land-use, eutrophication, and climate and will be used to predict the limitations that dispersal may play in moderating the invasion front.

ENRTF BUDGET: \$127,295

Outcome	Completion Date
1. We will collect and date sediment cores from the 20 Sentinel lakes and measure the <i>Cylindro</i> toxin (cylindrospermopsin) and the general Cyanobacteria toxin (microcystin) to determine when <i>Cylindro</i> arrived in Minnesota	February 2020
2. We will compare patterns of introduction and expansion of <i>Cylindro</i> to long-term weather data to assess the role of warming lake temperatures on range expansion vs. alternative invasion scenarios (i.e., eutrophication, human transport)	June 2021

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Final Update June 30, 2021

IV. DISSEMINATION:

Description: We will collaborate with our existing state agency partners at MPCA and MN DNR to provide these data in a form that will be publicly available. We will develop scientific reports and factsheets intended to inform managers and lay-persons on the spread of *Cylindro* in Minnesota and its environmental and public-health impacts. Research Station scientists will highlight this work at “Behind the Scenes” events, hosted three times a year by the Science Museum of Minnesota, which is open to all of the Museum’s thousands of daily visitors. We will publicize the progress and results of this project via the Research Station’s news releases and social media presence as well as through our ongoing collaboration with the University of Minnesota Extension HABS outreach efforts.

A final project report will document all findings for reference by state personnel, presentations at regional meetings will apprise stakeholders of our methods and results, and publications in peer-reviewed journals will inform the wider academic research community.

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Fourth Update June 30, 2020

Fifth Update January 31, 2021

Final Update June 30, 2021

V. PROJECT BUDGET SUMMARY:

A. Preliminary ENRTF Budget Overview: See attached spreadsheet

Explanation of Capital Expenditures Greater Than \$5,000: N/A

Explanation of Use of Classified Staff: N/A

Total Number of Full-time Equivalent (FTE) Directly Funded with this ENRTF Appropriation:

Enter Total Estimated Personnel Hours: 3609	Divide by 2,080 = TOTAL FTE: 1.74
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Total Number of Full-time Equivalent (FTE) Estimated to Be Funded through Contracts with this ENRTF Appropriation: N/A

Enter Total Estimated Personnel Hours:	Divide by 2,080 = TOTAL FTE:
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B. Other Funds:

SOURCE OF AND USE OF OTHER FUNDS	Amount Proposed	Amount Spent	Status and Timeframe
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Other Non-State \$ To Be Applied To Project During Project Period:			
Indirect costs at 40.83% waived by the Science Museum of Minnesota (in-kind)	\$ 81,660	\$	Secured
Other State \$ To Be Applied To Project During Project Period:			
	\$	\$	
Past and Current ENRTF Appropriation:			
M.L. 2016-186-2-04a: Tracking and Preventing Harmful Algal Blooms	\$ 500,000	\$ 95,000	Unspent
M.L. 2015-76-2-10 "Tracking and Preventing Harmful Algal Blooms"	\$ 93,000	\$ 93,000	Spent
Other Funding History:			
M.L. 2015-76-2-10 "Tracking and Preventing Harmful Algal Blooms"	\$ 93,000	\$ 93,000	Secured
M.L. 2014-226-2-3g: Watershed-Scale Monitoring of Long-Term Best-Management Practice	\$ 900,000	\$ 900,000	Secured

VI. PROJECT PARTNERS:

A. Partners receiving ENRTF funding

Name	Title	Affiliation	Role

B. Partners NOT receiving ENRTF funding

Name	Title	Affiliation	Role

VII. LONG-TERM IMPLEMENTATION AND FUNDING:

This project will provide the first baseline data on the distribution of the toxin-producing aquatic invasive species *Cylindro* through space and time. The St. Croix Watershed Research Station is currently collaborating with other research groups in Minnesota on HABs, including the St. Anthony Falls Hydraulics Laboratory, University of Minnesota Extension, and the Natural Resources Research Institute. We will continue that effort so that data collected for this and other ongoing projects will be shared collectively (including standardized protocols and inter-laboratory quality control) to provide the best possible scientific product for the people of Minnesota.

VIII. REPORTING REQUIREMENTS:

- The project is for 3 years, will begin on 07/01/2018, and end on 06/30/2021.
- Periodic project status update reports will be submitted 01/31 and 06/30 of each year.
- A final report and associated products will be submitted between June 30 and August 15, 2021.

IX. SEE ADDITIONAL WORK PLAN COMPONENTS:

- A. Budget Spreadsheet
- B. Visual Component or Map
- C. Parcel List Spreadsheet- N/A
- D. Acquisition, Easements, and Restoration Requirements- N/A
- E. Research Addendum

**Attachment A:
Environment and Natural Resources Trust Fund
M.L. 2018 Budget Spreadsheet**

Project Title: Determining Minnesota's risk of a toxic algal invader
Legal Citation: M.L. 2018, Chp. 214, Art. 4, Sec. 02, Subd. 06f
Project Manager: Adam Heathcote
Organization: Science Museum of Minnesota
College/Department/Division: St. Croix Watershed Research Station
M.L. 2018 ENRTF Appropriation: \$200,000
Project Length and Completion Date: 3 years, June 30, 2021
Date of Report: 2/22/2018



ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET	TOTAL BUDGET	TOTAL SPENT	TOTAL BALANCE
BUDGET ITEM			
Personnel (Wages and Benefits)	\$115,800		\$115,800
Heathcote, Associate Scientist: Phyto & Cylindro toxins; 33% FTE for 2 yrs; Salary=71%, Benefits=29% (\$56,300 over 2 years); this is a grant-funded position			
Edlund, Senior Scientist: Phyto & Cylindro toxins; 33% FTE for 1.5 yrs; Salary=71%, Benefits=29% (\$48,400 over 1.5 years); this is a grant-funded position			
Field and Laboratory Technician: Field work and lab analyses; 25% FTE for 1 yr; Salary=71%, Benefits=29% (\$11,100 over 1 years); this is a temporary position			
Professional/Technical/Service Contracts			
Equipment/Tools/Supplies			
Field and laboratory supplies: including bottles, reagents, calibration solutions, core tubes, sample cups	\$4,002		\$4,002
Cyanotoxin ELISA kits: Cylindrospermopsin (22 @ \$600 = \$13,200) Microcystin (22 @ \$600 = \$13,200)	\$26,400		\$26,400
Capital Expenditures Over \$5,000			
Printing			
Travel expenses in Minnesota			
Field travel to 20 lakes for monitoring Hotel: 2 persons for 8 nights @ \$76.50 = \$1,224 Per diem: 2 persons for 8 days @ \$36 = \$576 Mileage & gas: 3,530 miles @ \$0.545 = \$1,924	\$3,724		\$3,724
Field travel to 20 lakes for paleolimnology Hotel: 2 persons for 12 nights @ \$76.50 = \$1,836 Per diem: 2 persons for 12 days @ \$36 = \$864 Mileage & gas: 3,530 miles @ \$0.545 = \$1,924	\$4,624		\$4,624
Other			
Lab analysis of water samples: TN/TP: 20 @ \$36 DIN/SRP: 20 @ \$36 DOC: 20 @ \$20 DIC: 20 @ \$15 Fe: 20 @ \$36 SO4: 20 @ \$36 CYN toxin: 20 @ \$50 MC-LR toxin: 20 @ \$44	\$5,460		\$5,460
Lab analysis of sediment samples: 210-Pb (dating): 10 @ \$2,250 (\$22,500) loss-on-ignition: 20 @ \$800 (\$16,000)	\$38,500		\$38,500
QA/QC of ELISA cylindrospermopsin sediment samples via HPLC (inter-lab comparison via University of Minnesota or competitive bid) (\$1490)	\$1,490		\$1,490
COLUMN TOTAL	\$200,000		\$200,000