

**Environment and Natural Resources Trust Fund
2019 Request for Proposals (RFP)**

Project Title:

ENRTF ID: 104-BH

Fake Food: Man-made Materials in Aquatic Food Webs

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

Sub-Category: B. Water Resources

Total Project Budget: \$ 199,698

Proposed Project Time Period for the Funding Requested: June 30, 2021 (2 yrs)

Summary:

We will assess sources and impacts of anthropogenic “fake food” in aquatic food webs including effects of bioaccumulation in phytoplankton, zooplankton, fish, and Common Tern; a threatened species in Minnesota.

Name: Andrew Bramburger

Sponsoring Organization: U of MN - Duluth

Title: _____

Department: Natural Resources Research Institute

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Duluth MN 55811-1442

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Email abrambur@d.umn.edu

Web Address

Location

Region: Northeast

County Name: St. Louis

City / Township:

Alternate Text for Visual:

Image of “fake foods” on a penny for scale with an arrow that depicts the movement of “fake food” through food web that includes plankton, fish, and Common Tern.

_____ Funding Priorities	_____ Multiple Benefits	_____ Outcomes	_____ Knowledge Base
_____ Extent of Impact	_____ Innovation	_____ Scientific/Tech Basis	_____ Urgency
_____ Capacity Readiness	_____ Leverage	_____ TOTAL	_____ %
_____ If under \$200,000, waive presentation?			



PROJECT TITLE: Fake Food: Man-made Materials in Aquatic Food Webs

I. PROJECT STATEMENT

Globally, aquatic habitats have become increasingly contaminated with man-made items that can be mistakenly ingested by animals along with their natural diet items. These “fake food” items can consist of microplastics, but also metal flakes, paint particles, synthetic and naturally-derived fibers, and larger debris. While numerous reports have shown that these man-made items are present within aquatic systems throughout Minnesota, neither the prevalence of man-made items eaten by animals at various levels in aquatic food webs, nor the size distribution and ultimate source of these items, has been studied in the state. This project will evaluate the prevalence and size structure of man-made food items occurring in an aquatic ecosystem across multiple levels of the food web of the St. Louis River Estuary (SLRE) and Minnesota nearshore zone of Lake Superior. We will sample the water column to determine availability of man-made items for ingestion by aquatic organisms and sample gut contents of zooplankton, fishes, and Common Terns, an avian top predator in the system. Specific goals for this project include:

1. **Characterize the prevalence and size distribution of man-made items in each trophic level of the aquatic food web using a cutting-edge technology; multi-axis flow through imaging and measurement (FlowCam).**
2. **Identify of common sources of man-made items and help inform consumer and resource management decisions.**

It is estimated that 22 million pounds of refuse enter the Great Lakes each year. Although microplastics have garnered considerable attention in media and pose a specific set of threats to aquatic systems, they comprise only a small fraction of the man-made materials that can enter into aquatic food webs. Items ingested by low trophic level organisms, such as zooplankton, likely have cascading effects as they move up the aquatic food web. Man-made materials that mimic natural prey may bioaccumulate in food webs, potentially disrupting nutrient and energy transfer among organisms. This project will assess the distribution of man-made materials in relation to the Western Lake Superior Sanitary District (WLSSD) plant located on the St. Louis River, a potential point source for man-made items entering the food web.

II. PROJECT ACTIVITIES AND OUTCOMES

Activity 1: *Sampling and analysis of St. Louis River Estuary/Lake Superior nearshore aquatic food web*

ENRTF Budget: \$130,934

We will collect water, phytoplankton, zooplankton, and fish samples within the SLRE nearshore Lake Superior to quantify the prevalence of man-made items in the aquatic food web. Sites will be distributed throughout the study area based on Common Tern foraging habitat and in relation to WLSSD. Carcasses of juvenile Common Terns will be collected at Interstate Island, a tern nesting colony in the SLRE.

Outcome	Completion Date
1. Collect water & phytoplankton (10 net tows/site = 45,000L), zooplankton (10 samples x 10g/ site), and fish (up to 100/ site) samples at eight locations in the study area. Collect juvenile Common Tern carcasses (as many as available) from Interstate Island. Samples will be collected as tern chicks hatch, and again immediately before fledging.	August 2019
2. Process zooplankton, fish, and tern guts using a peroxide-based digestion method to dissolve organic tissues, leaving man-made materials for analyses. We anticipate processing and quantifying 100 samples representing water, zooplankton guts, fish guts, and tern guts.	April 2020



**Environment and Natural Resources Trust Fund (ENRTF)
2019 Main Proposal**

Activity 1: *Quantify abundance, size distribution, and dynamics of man-made items in aquatic food webs*

ENRTF Budget: \$68,764

We will use high throughput flow-through imaging techniques (FlowCam) to measure and enumerate man-made food mimics in each level of the food web. Man-made item size distribution will be used to infer the level at which items entered the food web, and their ultimate consumer product source. Item sources will provide insight into management practices that could decrease loadings to the system.

Outcome	Completion Date
1. Analyze samples using dynamic imaging particle analysis to identify and quantify man-made items using multi-axis flow through imaging and measurement (FlowCam) technology in order to quantify abundance and size distribution of man-made items in multiple food web levels	December 2020
2. Evaluate food web dynamics and bioaccumulation pathways of man-made items	April 2021
3. Develop resource management recommendations and disseminate findings to local organizations and state agencies	June 2021

III. PROJECT PARTNERS:

- A. Partners receiving ENRTF funding** N/A
- B. Partners NOT receiving ENRTF funding** N/A

IV. LONG-TERM- IMPLEMENTATION AND FUNDING:

This project will allow us to understand the sources and pathways that lead to ingestion of man-made items by Common Terns, a state-threatened species. Further, this project will provide novel insight into previously uninvestigated mechanisms of bioaccumulation of persistent anthropogenic food mimics within nearshore aquatic ecosystems. Results from this project will be broadly transferrable to other species, lakes, and food webs. Additional outcomes from this project will include outreach and education in the form of informational pamphlets, which will be provided to MN Department of Natural Resources, St. Louis River Alliance, and the National Estuarine Research Reserve. We will also train highly qualified personnel (two graduate students enrolled in the Integrated Biosciences graduate program at the University of MN Duluth). The results of this project will provide baseline information for a variety of longer-term studies on the effects of fake foods on organisms within Lake Superior estuarine, nearshore, and pelagic environments, as well as those of inland lakes throughout the state. Quantifying and categorizing man-made items will help inform consumers and regulatory agencies which materials are most prevalent in the water and which are most likely to bioaccumulate in the food web, which will be useful for regulation and management of Minnesota’s water resources.

V. TIME LINE REQUIREMENTS:

One year of data collection is required, with an additional year of data analysis and reporting, for a total of two years, from July 2019 through June 2021.

IX. SEE ADDITIONAL PROPOSAL COMPONENTS:

- A. Proposal Budget Spreadsheet**
- B. Visual Component or Map**
- C. Parcel List Spreadsheet**
- D. Acquisition, Easements, and Restoration Requirements**
- E. Research Addendum (not required at proposal stage)**
- F. Project Manager Qualifications and Organization Description**
- G. Letter or Resolution**
- H. Certified Audit or 990 Tax Information**

2019 Proposal Budget Spreadsheet

Project Title: Fake Food: Man-made Materials in Aquatic Food Webs

IV. TOTAL ENRTF REQUEST BUDGET 2 years

BUDGET ITEM	AMOUNT
Personnel:	\$ 180,088
Andy Bramburger, Principal Investigator: \$16,677 (fringe rate 33.5%); 8% FTE each year for 2 years	
Alexis Grinde, Co-Investigator: \$17,594 (fringe rate 33.5%); 8% FTE each year for 2 years	
Annie Bracey, Co-Investigator: \$36,772 (fringe rate 33.5%); 22% FTE each year for 2 years	
Josh Dumke, Fish Technician: \$8,357 (fringe rate 33.5%); 5% FTE each year for 2 years	
Field and Lab Technicians (2): \$22,252 (fringe rate 27.2%); 20% FTE each year for 2 years	
Graduate Research Assistants (2): \$78,436 (fringe rate 15%) and tuition reimbursement; 45% FTE each year for 2 years	
Professional/Technical/Service Contracts:	\$ 6,140
Fluid Imaging Technologies (\$6,140): Training and equipment use on site at Fluid Imaging Technologies. Includes technician training session (\$3,070) and unlimited access to instruments for size fraction particle analysis (\$3,070). Fluid Imaging Technologies is the only company in North America capable of performing these analyses. The costs of training and equipment use at their facility in Maine represent a savings compared to purchase of necessary instruments (2 x \$40,000) or per-sample costs for analysis (100 x \$150/sample).	
Equipment/Tools/Supplies:	\$ 3,465
Field supplies (\$850): Write in the Rain notebooks, sunblock, insect repellent, waders, gloves, sample nets, decontamination supplies.	
Chest freezer and monitor (\$1,065): Chest freezer for storing samples (\$1,000) + wireless monitor (\$45) and alert system for freezer (\$20)	
Lab supplies (\$1,550): Microplastics digestion supplies and reagents. 2 x 250 g FeSO4 ⁷ H2O @\$63 = \$126 (Fisher Scientific) + 6 x 1L H2O2 (30%) = \$881.59 (case of 6; Fisher Scientific) + NaCl (500g) @ \$62.12 + Dissecting tools and supplies @ \$480 = \$1,550	
Acquisition (Fee Title or Permanent Easements):	\$ -
Travel:	\$ 10,005
Field travel (\$8,140): Travel for fieldwork, including mileage for in-state travel to field survey sites (\$0.545/ mile), gas for operating boats needed to do water, phytoplankton, zooplankton, fish, and bird surveys in the Minnesota portion of the St. Louis River Estuary. Mileage costs are associated with rental of a field vehicle through the University of Minnesota motorpool for eight field sessions.	
Travel for particle analysis (\$1,865): Travel to receive specialized training and use equipment at the Fluid Imaging Technologies laboratory in Maine. Since Fluid Imaging Technologies is the only company with FlowCam technology, this highly specialized equipment combines flow cytometer with a digital imaging microscope that will allow us to identify "fake food" items. We will need to send one person to their laboratory for 5 days to process all samples. Costs include 5 nights x 1 person hotel @ \$139.50 + 5 days per diem x 1 person @\$51 + return flight \$800 + \$250 for car rental required for transportation between hotel and laboratory.	
Additional Budget Items:	\$ -
TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND \$ REQUEST =	\$ 199,698

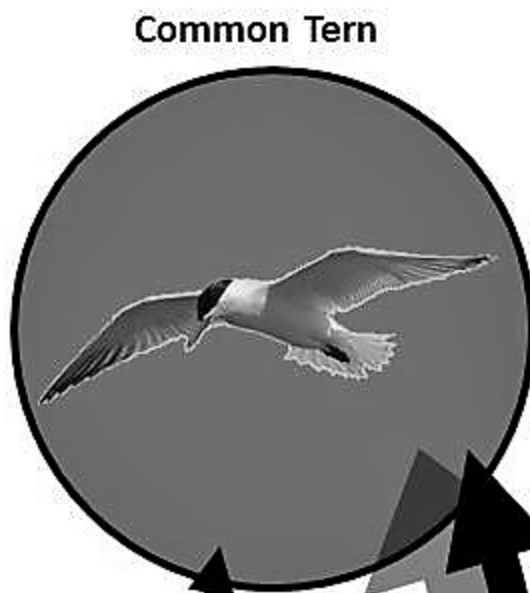
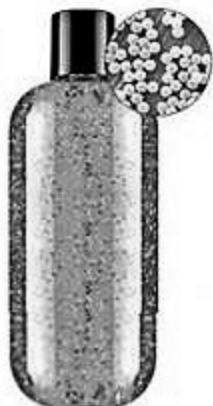
V. OTHER FUNDS

SOURCE OF FUNDS	AMOUNT	Status
Other Non-State \$ To Be Applied To Project During Project Period:	\$ -	N/A
Other State \$ To Be Applied To Project During Project Period:	\$ -	N/A
In-kind Services To Be Applied To Project During Project Period:	\$ -	
Unrecovered indirect: 54% on modified total direct costs (\$163,176 base, excludes grad tuition reimbursement)	\$ 88,115	Secured
Past and Current ENRTF Appropriation:	\$ -	N/A
Other Funding History:	\$ -	N/A

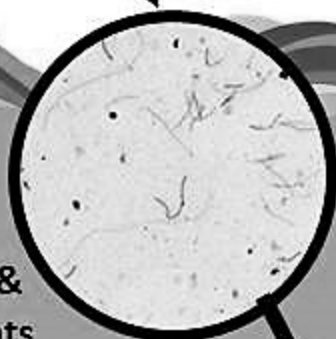
Fake Food!

Man-Made Materials in Aquatic Food Webs

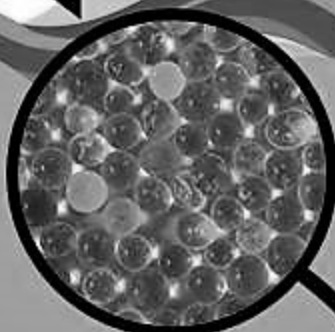
Consumer Goods



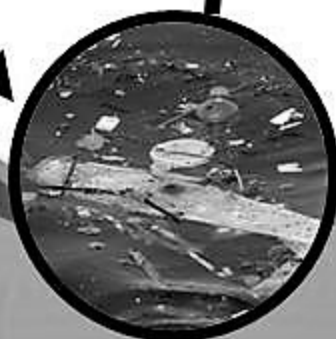
Common Tern



Fibers & Filaments



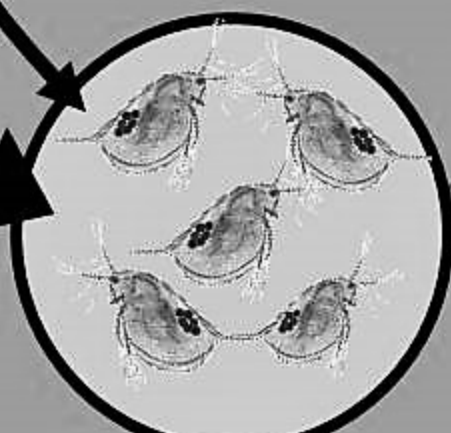
Beads & Small Debris



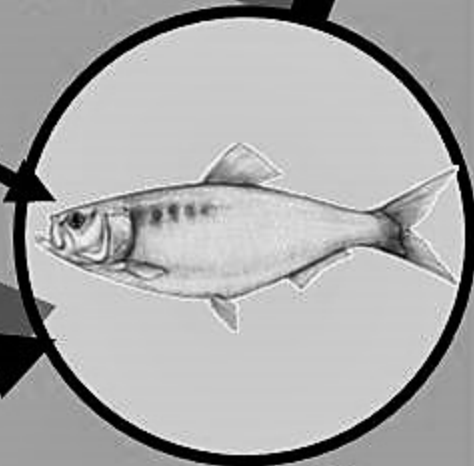
Large Debris



Phytoplankton



Zooplankton



Forage Fish

Arrow thickness denotes diet proportion

Appropriate Food Items

Man-made Food Mimics



Environment and Natural Resources Trust Fund (ENRTF) 2019 Project Manager Qualifications and Organization Description

PROJECT TITLE: Fake Food: Man-made Materials in Aquatic Food Webs

Dr. Andrew Bramburger, Natural Resources Research Institute (NRRI), University of Minnesota Duluth (UMD)

Dr. Bramburger is a Research Associate specializing in aquatic ecology at NRRI. He is a limnologist with expertise in algal taxonomy, community ecology, and environmental analysis. Dr. Bramburger has over 20 years of experience in aquatic science and has conducted studies integrating species ranging from algae to alligators in freshwater systems in multiple countries. Dr. Bramburger's expertise in algal dynamics and image analysis will contribute directly to the research activities related to this project. Further, Dr. Bramburger has managed several projects of this scope and complexity under grants from state and federal agencies. Dr. Bramburger will be supported by Dr. Grinde, a Research Associate at NRRI, specializing in avian ecology, Ms. Bracey, a graduate student at the U of MN, with expertise in conservation and management needs of the Great Lakes population of common terns, and Mr. Dumke, a Sr. Research Scientist at NRRI, specializing in fisheries biology and aquatic ecology.

EDUCATION

Ph.D. (2011). Environmental Science – Great Lakes Institute for Environmental Research, University of Windsor.
M.Sc. (2005). Biological Sciences, Ecology and Evolution Stream – Department of Biological Sciences, University of Windsor.
Honours B.Sc. (2002). Environmental Biology (Co-Op) – Department of Biological Sciences, University of Windsor.

SELECTED PUBLICATIONS

Bramburger, A.J., Brown, R.S., Haley, J. & Ridal, J.J. (2015) A new, rapid, automated fluometric method for the detection of *Escherichia coli* in recreational waters at St. Lawrence River Beaches. *Journal of Great Lakes Research* 41: 298-302.

Bramburger, A.J. & Reavie, E.D. (2016) A comparison of phytoplankton communities of the deep chlorophyll layers and epilimnia of the Laurentian Great Lakes. *Journal of Great Lakes Research* 42: 1016-1025.

Waller, M.E., Bramburger, A.J., & Cumming, B.F. (2016). Bi-weekly changes in phytoplankton abundance in 25 tributaries of Lake St. Francis, Canada: evaluating the occurrence of nuisance and harmful algae. *Journal of Great Lakes Research* 42: 1049-1059.

Reavie, E.D., Sgro, G.V., Estep, L., Bramburger, A.J., Chraïbi, V.L.S., Pillsbury, R.W., Cai, M., Stow, C. & Dove, A. (2016) Climate warming and changes in *Cyclotella sensu lato* in the Laurentian Great Lakes. *Limnology and Oceanography* 62: 768-783.

Bramburger, A.J., Reavie, E.D., Sgro, G.V., Estep, L.R., Chraïbi, V.L.S. & Pillsbury, R.W. (2017) Decreases in diatom cell size over the course of the 20th century in the Laurentian Great Lakes: A response to warming waters? *Journal of Plankton Research* 39: 199-210.

Bramburger, A.J., Hamilton, P.B., & Haffner, G.D. (2017) Effects of long-term anthropogenic disturbance on the benthic, episammic diatom community of an ancient, tropical lake. *Bulletin of Environmental Contamination and Toxicology* 99: 542-547.

ORGANIZATION DESCRIPTION

The Natural Resources Research Institute is a University of Minnesota Duluth applied research organization. NRRI's mission is to deliver research solutions to balance Minnesota's economy, resources and environment for resilient communities.