



Great Waters Research Collaborative R&D Plan

Great Lakes Panel on Aquatic Nuisance Species, June 1-3, 2022

Dr. Jen Maki



R&D Plan Goal

- Addressing stated purposes of Vessel Incidental Discharge Act of 2018 (in Coast Guard Authorization Act of 2018):

To identify approaches, methods, and best available technologies that are effective at reducing propagules in Great Lakes ballast water, thereby decreasing the environmental risk associated with the ballast water vector from vessels operating exclusively within the Great Lakes System.

R&D Plan Outreach

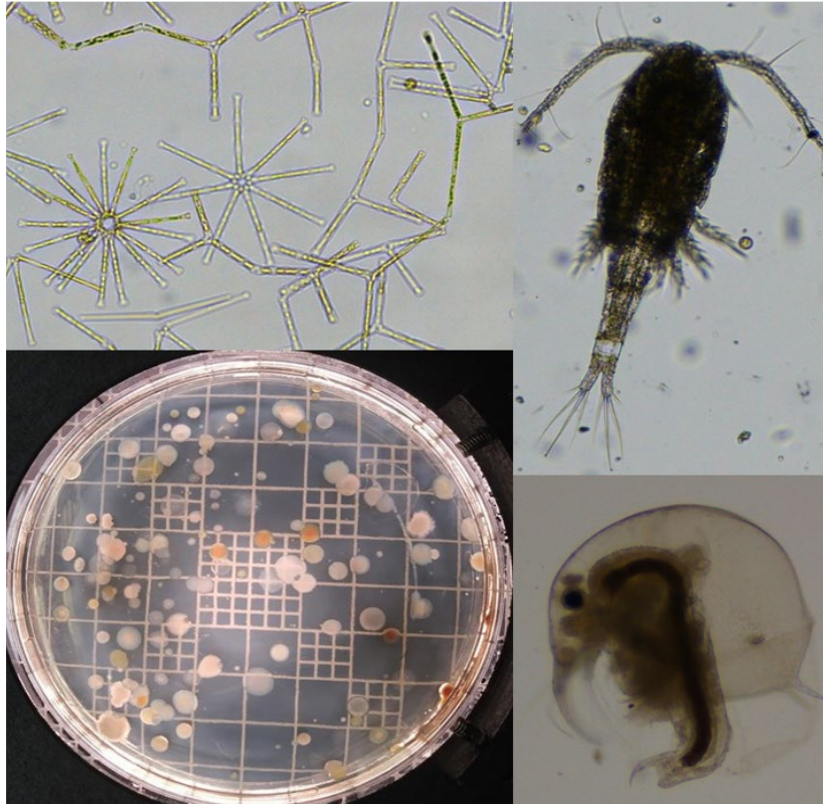
Public Comments

- Comment period ended 31 March 2021
- Four sets of comments received
 - Hull & Associates
 - Environmental Quality Operations
 - Dalhousie University
 - Great Lakes Panel on Aquatic Nuisance Species
- Comments were
 - summarized and discussed with EPA
 - incorporated into v.5 of R&D plan

Other Outreach Activities

- Received comments from Stakeholder Group
 - Transport Canada
 - Others likely commented as part of GLP ANS
- Received data from Data Working Group
 - Lake Carriers' Association
 - Chamber of Marine Commerce
 - Naval Research Lab
 - Department of Fisheries and Oceans Canada
 - Transport Canada

Effective Reduction of Propagules in Great Lakes Ballast Water



**Research
Area 1**

Finding effective
ballast water
management
strategies

**Research
Area 2**

Developing Great
Lakes-specific
ballast water
sample analysis
methods

**Research
Area 5**

Assessing the risk of
aquatic nuisance
species transfer

Research Area 1, Project 1 – Operational Characteristics of Vessels Trading in the Great Lakes

- What are the typical (and more challenging) ballasting operational characteristics of US and Canadian flag commercial vessels that trade within the Great Lakes?
- Need to know “internal” characteristics of vessels so BWMS options can be identified.
- Received majority of data – data sets are being proofed for accuracy, analysis starting in June 2022.

Research Area 1, Project 2 Progress – Land Based Evaluation of Compliant and USCG Type Approved BWMS in Great Lakes Water

- Optimarin Ballast System, Model 334/340FX2 - UV system (400-1100 W/m²) and filter (20 microns).
- Bawat Ballast Water Management System Mk2 – Mobile Treatment Unit, Bawat A/S Agern Alle, 2970 Horsholm, heat pasteurization.

Optimarin – Treated Discharge Data

Test Cycle	$\geq 50 \mu\text{m}$ (live/ m^3)	$\geq 10 \mu\text{m}$ and $< 50 \mu\text{m}$ live (cells/mL) <i>Strictly ETV</i>	$\geq 10 \mu\text{m}$ and $< 50 \mu\text{m}$ live (cells/mL) <i>Adapted</i>	Total heterotrophic bacteria (CFU/mL)
Commission	2.9	11	29	490
1	7.8	51	79	128
2	2.1	51	74	230
3	4.1	41	57	140
4	6.4	21	28	310
5	100.6	24	66	170

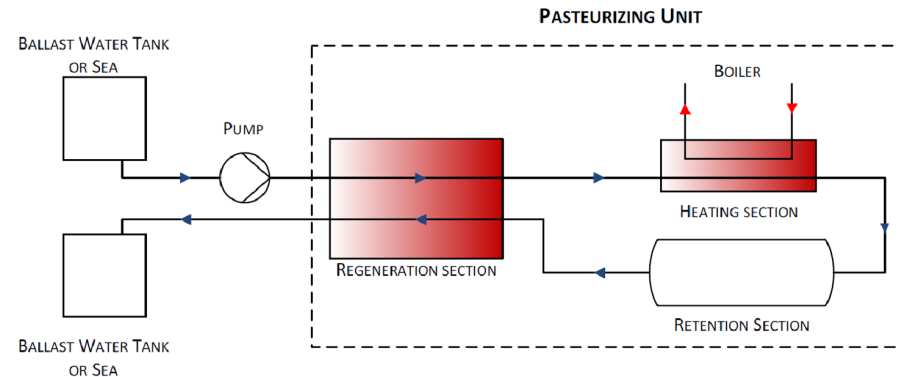
$\geq 50 \mu\text{m}$ = <10 viable organisms per cubic meter
 $\geq 10 \mu\text{m}$ and $< 50 \mu\text{m}$ live = <10 viable organisms per milliliter
 Cholerae less than 1 colony forming unit (cfu) per 100 milliliters
 E. coli less than 250 cfu per 100 milliliters
 Enterococci less than 100 cfu per 100 milliliters



Test Cycle	$\geq 50 \mu\text{m}$ (live/ m^3)	$\geq 10 \mu\text{m}$ and $< 50 \mu\text{m}$ live (cells/mL) <i>Strictly ETV</i>	$\geq 10 \mu\text{m}$ and $< 50 \mu\text{m}$ live (cells/mL) <i>Adapted</i>	Total heterotrophic bacteria (CFU/mL)
Commission	0	2	22	290
1	0	5	19	580
2	0	3	9	350
3	0	4	49	310
4	0	19	22	230

Bawat – Treated Discharge Data

$\geq 50 \mu\text{m}$ = <10 viable organisms per cubic meter
 $\geq 10 \mu\text{m}$ and $< 50 \mu\text{m}$ live = <10 viable organisms per milliliter
 Cholerae less than 1 colony forming unit (cfu) per 100 milliliters
 E. coli less than 250 cfu per 100 milliliters
 Enterococci less than 100 cfu per 100 milliliters



Land Based Testing 2022

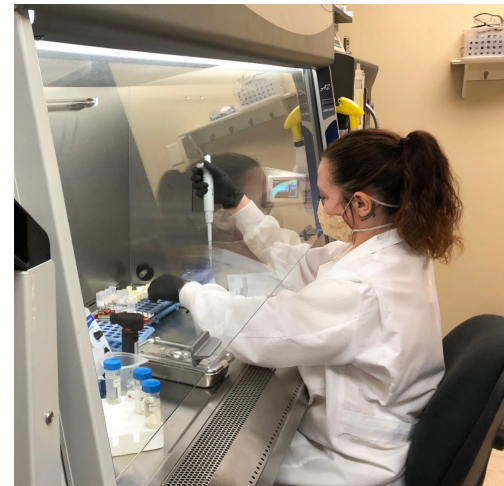
- Optimarin – new lamp suited for turbid/stained waters, already on site.
 - Test plan written
 - Starting June 2022
- Filter comparison test – research project designed to fill data gaps associated with filter performance under Great Lakes conditions of water quality and biology (ice, filamentous algae, etc.)
 - Finalizing experimental design, issue RFA
 - Starting fall 2022

Research Area 1, Project 3- Shipboard Evaluation of Compliant and USCG Type Approved BWMS in Great Lakes Water

- RFP – 1
 - Interlake Logistics, BIO-UV Group, and Choice Ballast Solutions
 - BIO-SEA B (filter and UV)
 - ATB UNDAUNTED/PERE MARQUETTE
 - Sampling begins in Q2 or Q3 of 2022
- RFP – 2
 - BAWAT – Shoreside treatment system
 - Pasteurization
 - Port of Duluth-Superior – ships off load ballast
 - Sampling begins in 2022
 - VanEnkevort Tug and Barge
 - DESMI (filter and UV) – installed but not commissioned
 - Dirk S. VanEnkevort/Michigan Trader
 - Sampling begins in Q3 of 2022

Research Area 2, Project 2 – Development of Viability Assessment Methods for the Great Lakes

- Viability assessment
 - Lab optimization of viability analysis technique
 - Ran six comparison trials at the Montreal Pier Facility with a UV-based BWMS
 - Analysis completed using ETV method and viability assessment method
 - Both methods appear to show the same trends
 - Currently analyzing this data
 - Precision and accuracy of viability method



Preliminary Data: Viability Assessment Method with Optimarin (UV system)

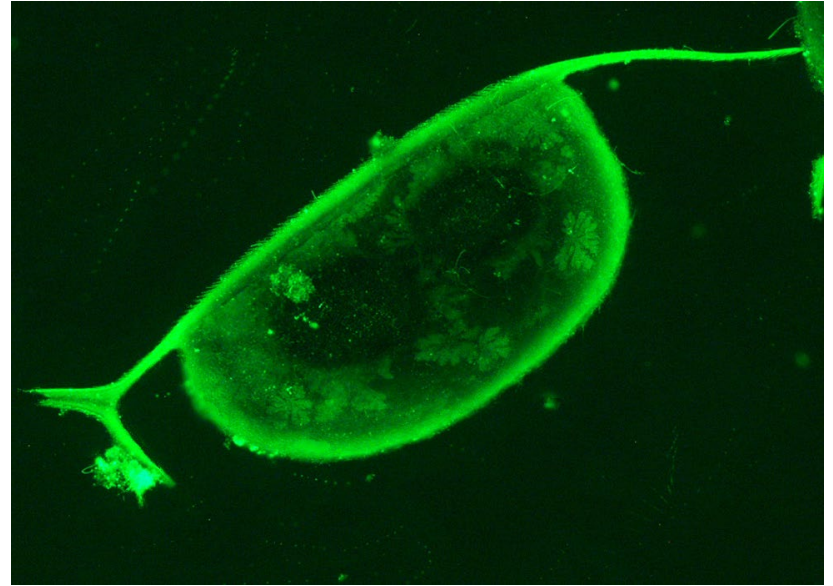
Test Cycle	$\geq 10 \mu\text{m}$ and < $50 \mu\text{m}$ live (cells/mL) <i>Strictly ETV</i>	$\geq 10 \mu\text{m}$ and < $50 \mu\text{m}$ <u>viable</u> (cells/mL)	$\geq 10 \mu\text{m}$ and < $50 \mu\text{m}$ live (cells/mL) <i>Strictly ETV</i>	$\geq 10 \mu\text{m}$ and < $50 \mu\text{m}$ <u>viable</u> (cells/mL)
	<i>Control Discharge</i>		<i>Treatment Discharge</i>	
Commission	972	1572	11	2.8
1	2109	8342	51	0.7
2	2188	1699	51	0.3
3	1848	1353	41	0.0
4	977	3400	21	0.2
5	350	647	24	0.2

Viability assessment method indicate <10 cells/mL for all trials.

In process of analyzing community composition data for uptake and discharge samples to look at growability of the ambient community.

Research Area 2, Project 3 – Assessment of Resting Stages of Plankton in Ballast Water

- Planktonic eggs and/or resting stages
 - Staining produced variable results
 - Examine preserved uptake samples (n=76) to determine what proportion of the population are resting stages, eggs, embryos, etc.



Research Area 5, Project 2, Using Semi-field Methodologies to Determine the Impact of ANS Reduction in Managed Ballast Water

- Semi-field methods to determine impact of ANS reduction
 - Three completed experiments each for protist and *Bythotrephes* introductions
 - Spiked organisms were able to persist, did not observe infestation like we saw with *Melosira* in earlier experiments
 - eDNA processing is ongoing, results on DNA-microscopy comparisons soon
 - June 1, 2022, will explore new "invader" organisms

Research Area 1, Project 6, Evaluating Feasibility and Significant Impacts of Ballast Water Reception Facilities within the Great Lakes

- What is the feasibility, economic, and environmental impact of reception facilities if utilized within the Great Lakes under certain scenarios or locations?
- Dr. Dennis King of King and Associates, LLC will lead this project.
- Start date of June 1, 2022.

Summary

Ballast water management strategies

- Encouraging performance of BWMS in tests at the Montreal Pier Facility
- Shipboard sampling starts this summer
 - BWMS are installed

Sample analysis methods development

- Viability assessment
 - Precision and accuracy
- Resting stages of plankton
 - Staining methods produced variable results

ANS transfer risk assessment

- eDNA and microscopy comparison is underway
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