

**Survival and growth of newly transformed *Lampsilis*
cardium and *L. siliquoidea* in a flow through continuous
feeding test system**

**J.R. Meinertz, T.M. Schreier,
Karina R. Hess, and Michelle R. Bartsch**

**U.S. Geological Survey
Upper Midwest Environmental Sciences Center
La Crosse, WI**

**St. Croix River Research Rendezvous
Marine on St. Croix, MN
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Proposal development

Natural Resources Preservation Program
Demonstration of an approach to assess
the impact of emerging contaminants on
aquatic invertebrates in national parks:
National Park Service
A project for the St. Croix National
Water Resources Division
Scenic Riverway
Mounds View, MN

Emerging contaminants

Pharmaceuticals and personal care products

- ✓ prescription & over the counter drugs
- ✓ detergent by-products
- ✓ fragrances
- ✓ cosmetics
- ✓ sunscreen agents
- ✓ diagnostic agents

A potential problem???

- ✓ **continually introduced**
- ✓ **continuously exposed**
- ✓ **persist through time**
- ✓ **little work describing chronic effects**
- ✓ **mixture effects basically unknown**

Project objectives

- (1) Determine presence and concentration of PPCP in water and sediment**
- (2) Determine effects of PPCP found in the river on daphnia**
- (3) Develop juvenile mussel chronic exposure methodology and determine effects of PPCP found in the river on mussels**



**Challenge attaining “good” survival
with newly transformed mussels**

**Survival “good” until 2 weeks,
then substantially decreased**

**Survival near 80% with low
variability in control groups**



**Preliminary 56 day trial with
*L. cardium***

48% survival, 31% precision



For the next trial we made some modifications

Different food types

Glochidia were in the brood chamber longer

Side by side comparison with 2 species



**Infested largemouth bass with
glochidia**

**Peak drop off day
L. siliquoidea, day 16
L. cardium, day 17**

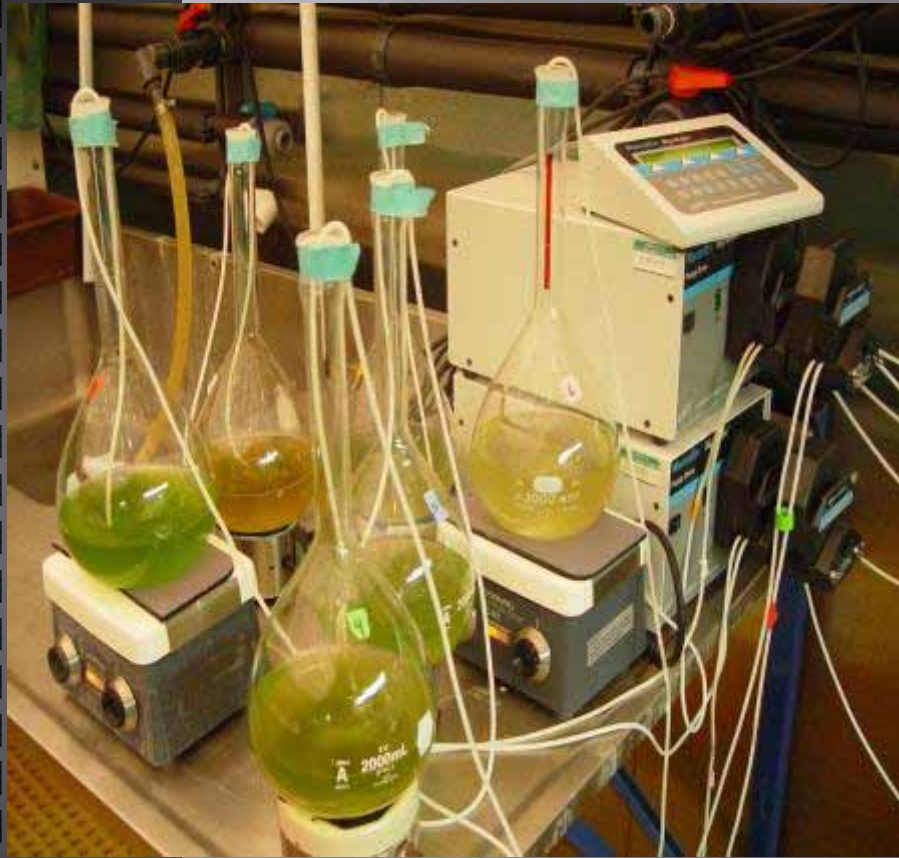
The test system

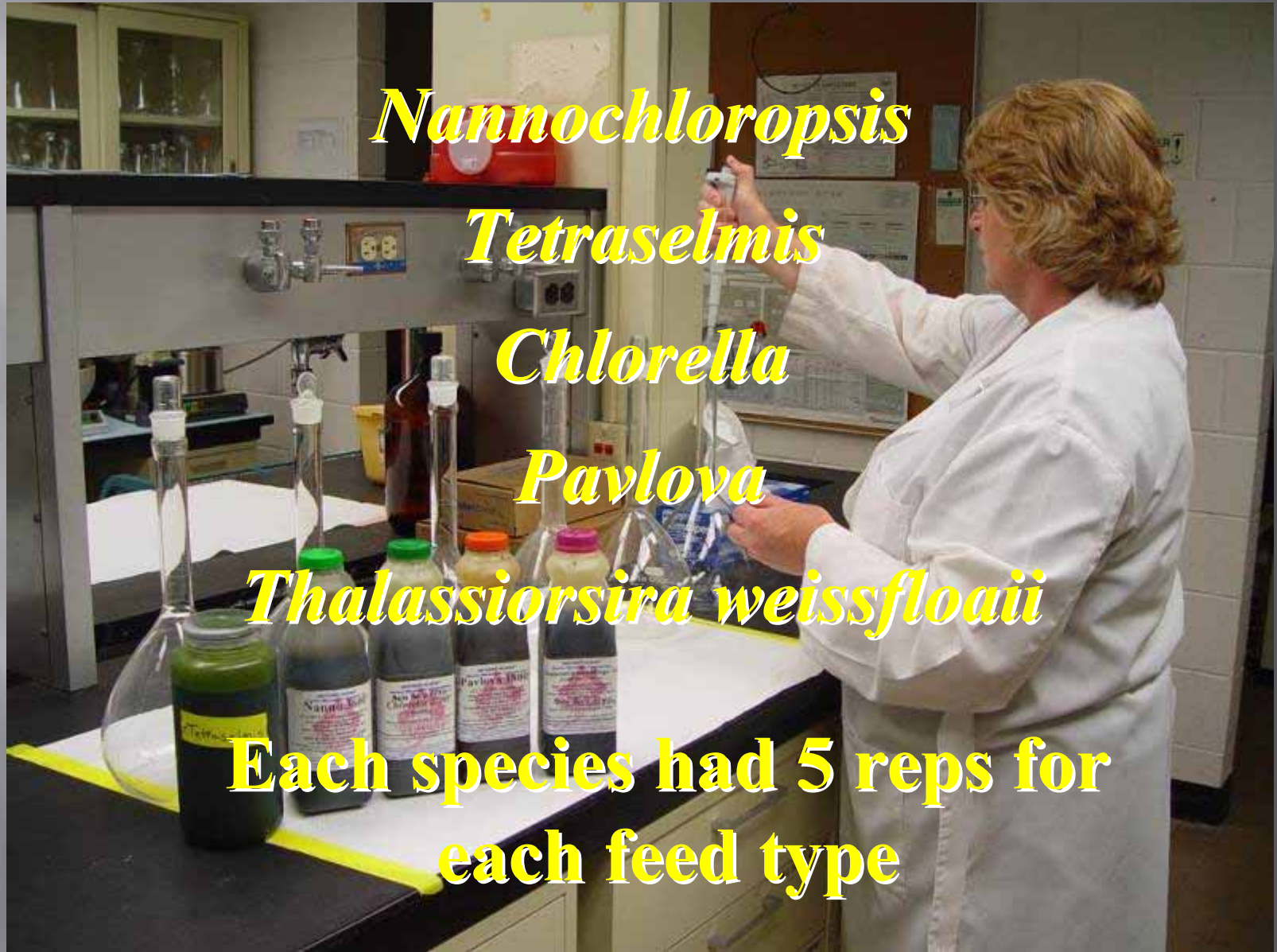


Test chambers



Food delivery system





Nannochloropsis

Tetraselmis

Chlorella

Paylova

Thalassiosira weissflogii

Each species had 5 reps for
each feed type

**Live and dead mussel
collection after the 28 day trial**



Length measurements

The screenshot displays the Image-Pro Express software interface. The main window shows a photograph of three diatoms with red lines indicating length measurements. The 'Measurements' window at the bottom left provides a summary of the measurements:

Features	Measurement	Value	Nominal Val.	Min. Tol.	Max. Tol.	F
1 L1	Length	484.3924	484.3924	-0.010	0.010	✓
2 L2	Length	625.7394	625.7394	-0.010	0.010	✓
3 L3	Length	499.6412	499.6412	-0.010	0.010	✓

To the right, a Microsoft Excel spreadsheet titled 'siliquoidea Feed 3 measurements' displays the following data:

	A	B	C	D	E	F	G	H
1			Features	Measurer	Value	Nominal	Min. Tol.	Max.
2	1	1	L1	Length	407.7662	407.7662	-0.001	0
3	2	2	L2	Length	477.1734	477.1734	-0.001	0
4	3	3	L3	Length	631.0234	631.0234	-0.001	0
5	4		broken					
6			Features	Measurer	Value	Nominal	Min. Tol.	Max.
7	5	1	L5	Length	582.2688	582.2688	-0.001	0
8	6	2	L6	Length	451.882	451.882	-0.001	0
9	7	3	L7	Length	486.4065	486.4065	-0.001	0
10	8	4	L8	Length	432.6552	432.6552	-0.001	0
11	9	5	L9	Length	536.3914	536.3914	-0.001	0
12			Features	Measurer	Value	Nominal	Min. Tol.	Max.
13	10	1	L3	Length	483.1489	483.1489	-0.001	0
14	11	2	L4	Length	503.2749	503.2749	-0.001	0
15			Features	Measurer	Value	Nominal	Min. Tol.	Max.
16	12	1	L1	Length	484.3924	484.3924	-0.001	0
17	13	2	L2	Length	625.7394	625.7394	-0.001	0
18	14	3	L3	Length	499.6412	499.6412	-0.001	0
19								
20								
21								
22								
23								
24								
25								

<i>L. cardium</i> Feed type	Mean percent recovered	Overall percent recovered
<i>Nannochloropsis</i>	84.5	83.6
<i>Nannochloropsis/Tetraselmis</i>	84.0	
<i>Nannochloropsis/Tetraselmis/Chlorella</i>	79.0	
<i>Nannochloropsis/Thalassiosira weissflogii</i>	84.0	
<i>Nannochloropsis/Pavlova</i>	81.0	
<i>Nannochloropsis/Thalassiosira weissflogii/Pavlova</i>	89.0	

<i>L. siliquoidea</i> Feed type	Mean percent recovered	Overall percent recovered
<i>Nannochloropsis</i>	83.0	87.3
<i>Nannochloropsis/Tetraselmis</i>	83.5	
<i>Nannochloropsis/Tetraselmis/Chlorella</i>	88.0	
<i>Nannochloropsis/Thalassiosira weissflogii</i>	91.0	
<i>Nannochloropsis/Pavlova</i>	88.5	
<i>Nannochloropsis/Thalassiosira weissflogii/Pavlova</i>	89.5	

<i>L. cardium</i> Feed type	Percent survival	Variability (%rsd)
<i>Nannochloropsis</i>	66.0	23
<i>Nannochloropsis/Tetraselmis</i>	43.5	50
<i>Nannochloropsis/Tetraselmis/Chlorella</i>	60.5	11
<i>Nannochloropsis/Thalassiosira weissflogii</i>	51.0	52
<i>Nannochloropsis/Pavlova</i>	12.0	99
<i>Nannochloropsis/Thalassiosira weissflogii/Pavlova</i>	23.5	42

<i>L. siliquoidea</i> Feed type	Percent survival	Variability (%rsd)
<i>Nannochloropsis</i>	67.1	20
<i>Nannochloropsis/Tetraselmis</i>	56.5	34
<i>Nannochloropsis/Tetraselmis/Chlorella</i>	80.0	13
<i>Nannochloropsis/Thalassiosira weissflogii</i>	74.8	8.7
<i>Nannochloropsis/Pavlova</i>	42.5	63
<i>Nannochloropsis/Thalassiosira weissflogii/Pavlova</i>	33.5	35

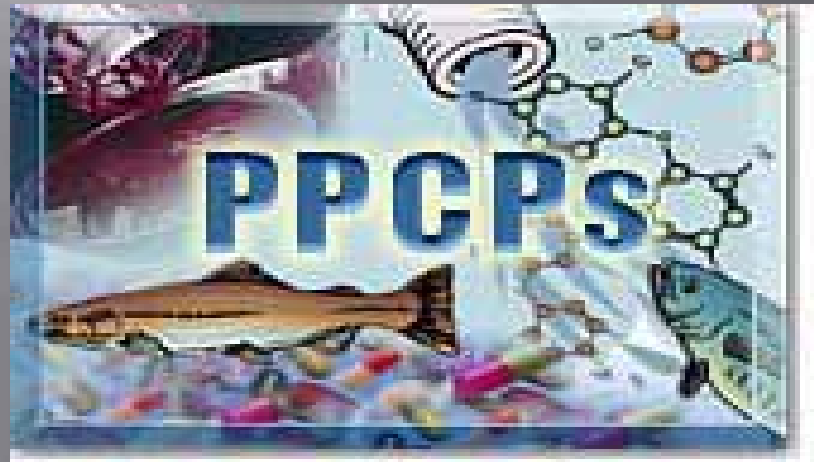
<i>L. cardium</i> Feed type	Valve length (μm)	Growth rate ($\mu\text{m}/\text{day}$)
<i>Nannochloropsis</i>	512	8.2
<i>Nannochloropsis/Tetraselmis</i>	437	5.5
<i>Nannochloropsis/Tetraselmis/Chlorella</i>	612	11.8
<i>Nannochloropsis/Thalassiosira weissflogii</i>	535	9.0
<i>Nannochloropsis/Pavlova</i>	510	8.1
<i>Nannochloropsis/Thalassiosira weissflogii/Pavlova</i>	476	6.9

<i>L. siliquoidea</i> Feed type	Valve length (μm)	Growth rate ($\mu\text{m}/\text{day}$)
<i>Nannochloropsis</i>	495	7.4
<i>Nannochloropsis/Tetraselmis</i>	464	6.3
<i>Nannochloropsis/Tetraselmis/Chlorella</i>	643	12.7
<i>Nannochloropsis/Thalassiosira weissflogii</i>	509	7.9
<i>Nannochloropsis/Pavlova</i>	471	6.6
<i>Nannochloropsis/Thalassiosira weissflogii/Pavlova</i>	485	7.1

Conclusion

A chronic toxicity trial continuously exposing newly transformed mussels to a pharmaceutical compound can be conducted for at least 28 days with adequate survival and variability within the control treatment group.

UMESC Pharmaceuticals in Aquatic Environments Team



Thank you for your attention!