



Efficacy of Formulated *Pf*-CL145A (Zequanox[®]) for Zebra Mussel Control in Simulated Open Water Treatments

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J.A. Luoma¹, T.J. Severson¹, K.L. Weber¹, J.K. Wise¹,
J.P. Motquin^{2*}, D.A. Mayer³, and N.W. Olson⁴

¹Upper Midwest Environmental Sciences Center, La Crosse, Wisconsin 54603

²Shawano County Land Conservation Division, Shawano, Wisconsin 54166

³New York State Museum Field Research Laboratory, Cambridge, NY

⁴MN DNR, Ecological and Water Resources, Fergus Falls, MN

*Presenting author

U.S. Department of the Interior
U.S. Geological Survey



Partnership



Genoa
National
Fish
Hatchery

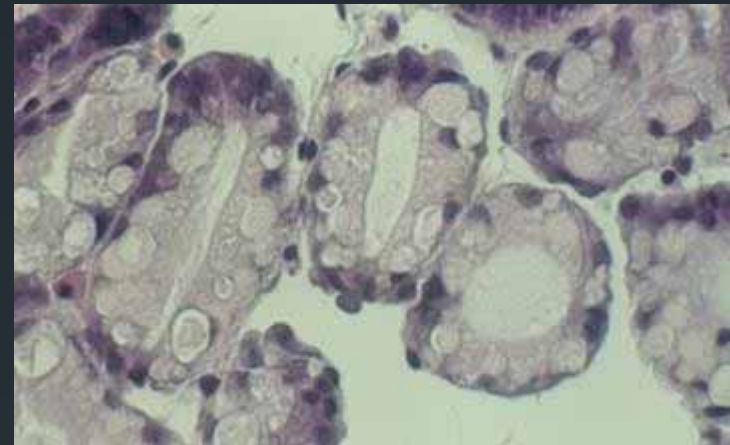


Shawano
County Land
Conservation
Division

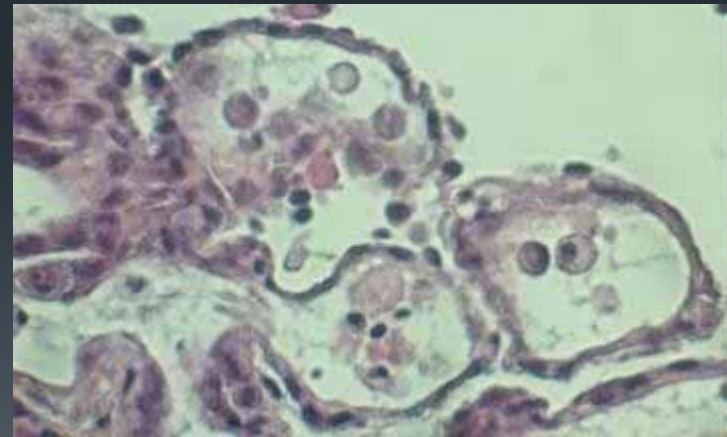


Discovery of *Pf*-CL145A

- Common soil bacterium
- Targets digestive gland
- Zequanox[®]
 - Registered with USEPA
 - Defined discharge
 - Tolerance exempt
 - 50% w/w *Pf*-CL145A
 - Proprietary killed-cell formulation



Normal tubule



Necrotic tubule

UMESC Grant Objectives

- **Non-target animal safety**

- Unionid mussels

- Glochidia

- Juveniles

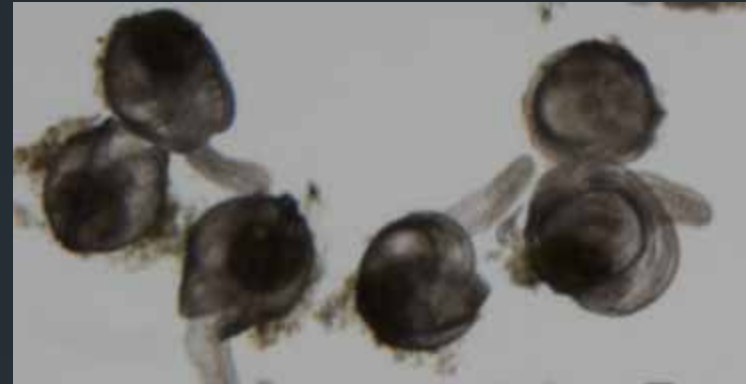
- Sub-adults

- Young-of-year fish

- **Treatment efficacy**

- **Simulated field trials**

- In-Lake enclosures



Simulated Open Water Treatments

- Evaluate efficacy of formulated *Pf*-CL145A for controlling zebra mussels
- Treatment method development
 - Duration
 - Concentration
 - Application



Mobile Wet Laboratory

- Self-contained unit
- 25 gpm pump with VFD
- Automatic backwash filtration system
- Multiple effluent management options
- Modular tank system



Test Tanks



Pump system



Removal of Treated Water

Study Parameters

- **Locations**

- Lake Carlos (MN)
- Shawano Lake (WI)

- **Application Techniques**

- Whole Water Column
- Injection

- ***Pf-CL145A* Treatments**

- Control
- 50 mg/L
- 100 mg/L



Test Animal Collection



Collecting Zebra Mussels



Seeding
Substrate



Stack
Seeded
Substrate



Stacks
into
Cages

Distribution of Test Animals

- One substrate per bag
 - > 50 attached ZM/tray
 - Empty shells removed
 - Closed with zip-ties
- Bags randomly assigned exposure chamber, tagged and suspended at bottom of tanks



Prepared
Bag



Suspending
bags

Dosing and Exposure

- Dosing
 - 0, 50, 100 mg/L active
 - Triplicate tanks
- Whole Water Column Dosing
 - 9 bags per tank
 - 6, 9, and 12 hour exposures
- Injection Dosing
 - 3 bags per tank
 - 12 hour exposure only



Whole
Water
Column
Dosing

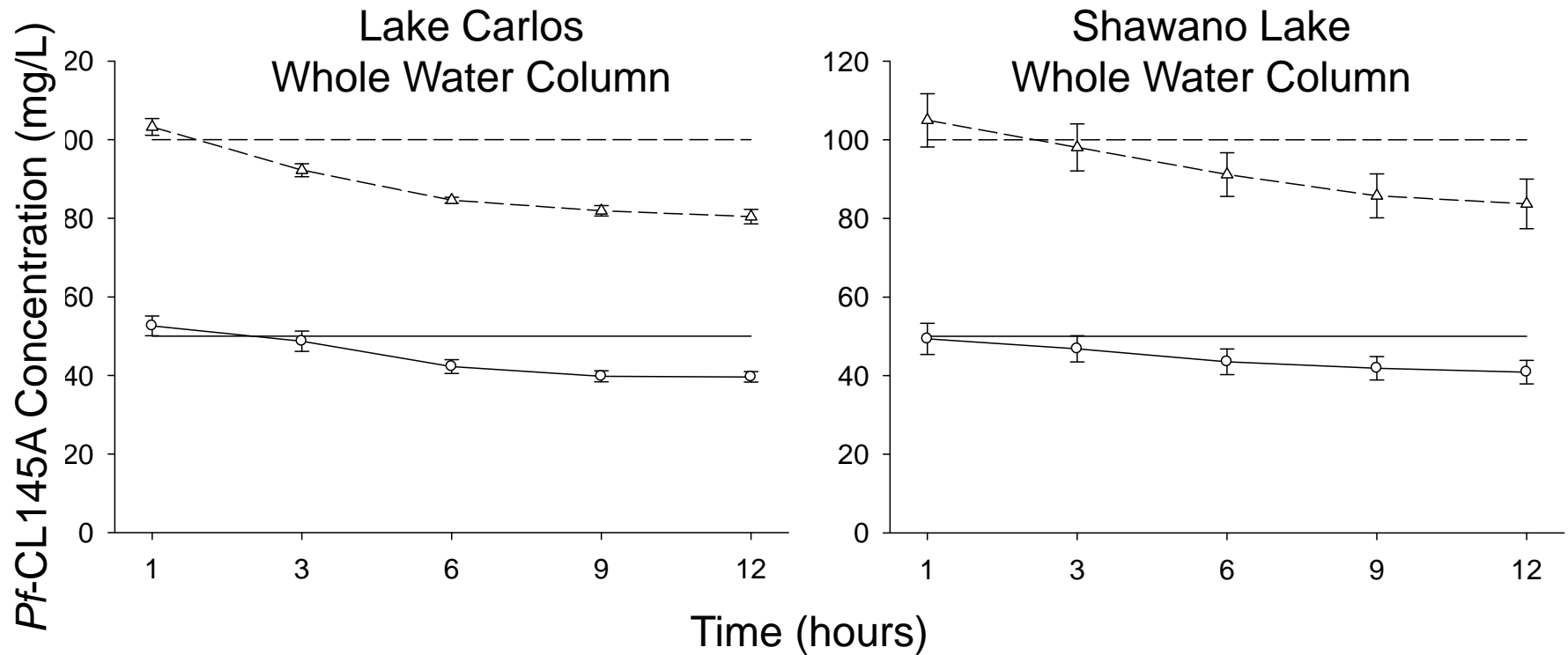


Injection
Dosing

Lake Water Chemistry

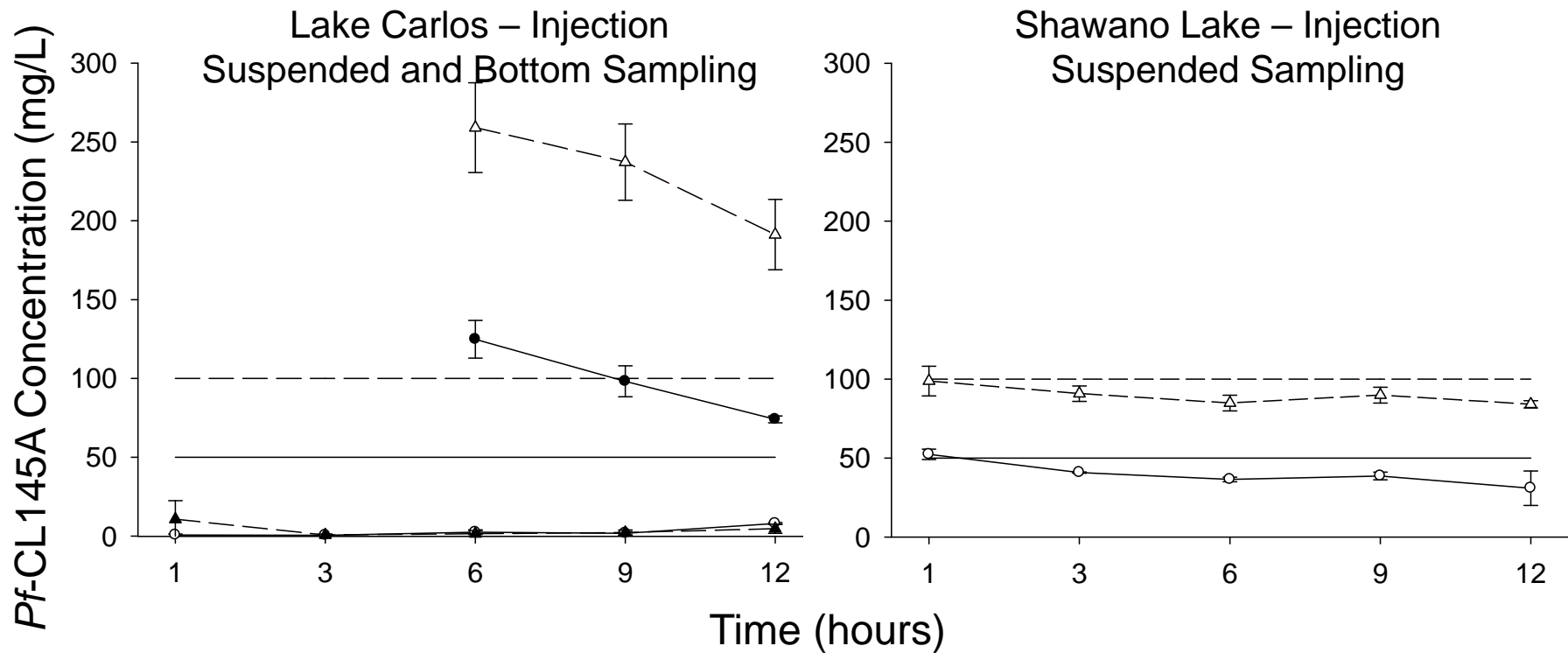
Treatment Location/type	pH Range	Dissolved Oxygen mg/L (STD)	Temperature °C (STD)	Hardness mg/L (STD)	Alkalinity mg/L (STD)	Conductivity μS/cm (STD)
Lake Carlos _w	8.60 – 8.65	8.76 (0.02)	22.2 (0.05)	177 (1.1)	163 (0.55)	395 (1.5)
Lake Carlos _i	8.69 – 8.70	8.41 (0.02)	21.2 (0.03)	177 (1.0)	164 (0.41)	363 (3.3)
Shawano Lake _w	9.31 – 9.34	7.36 (0.02)	22.6 (0.03)	118 (0.8)	105 (0.52)	248 (1.9)
Shawano Lake _i	9.10 – 9.14	7.43 (0.02)	19.5 (0.00)	125 (1.1)	112 (0.55)	231 (2.6)

Spectrophotometric Data



- Target Conc. 50 mg/L
- Actual Conc. 50 mg/L
- - - Target Conc. 100 mg/L
- -△- Actual Conc. 100 mg/L

Spectrophotometric Data



- Target Conc. 50 mg/L
- Actual Conc. Suspended 50 mg/L
- Actual Conc. Bottom 50 mg/L
- — Target Conc. 100 mg/L
- ▲— Actual Conc. Suspended 100 mg/L
- △— Actual Conc. Bottom 100 mg/L

Pf-CL145A Injection



Lake Carlos



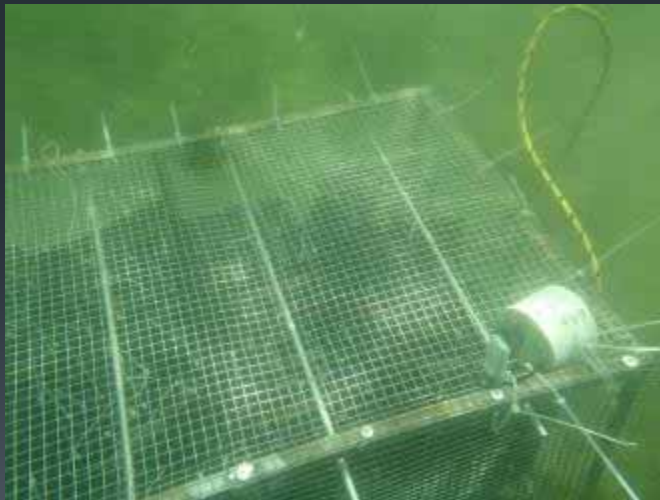
Shawano Lake



Post-Dosing

- Bags removed and rinsed
- Placed in holding cages
- Held in lake for ~ 30 days
- Assessed Survival

Holding
Cage



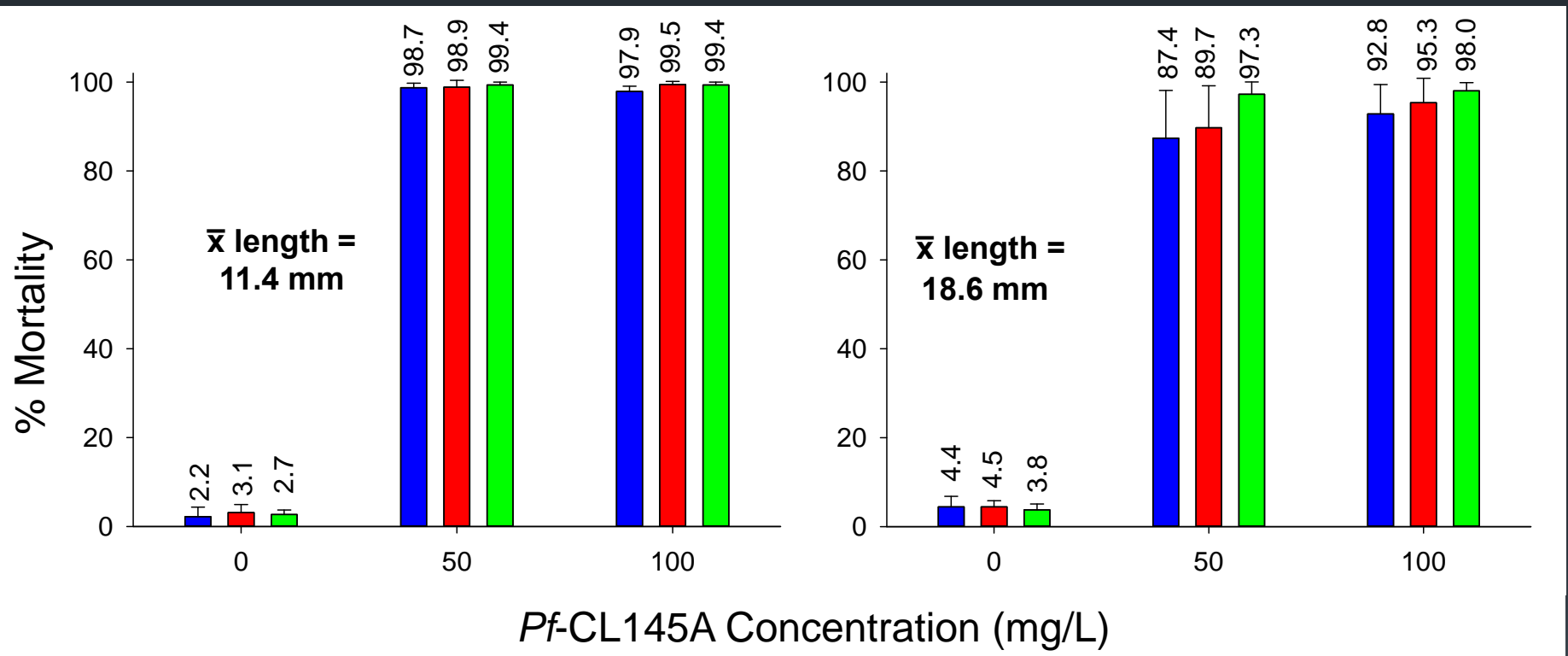
Survival
Assessment



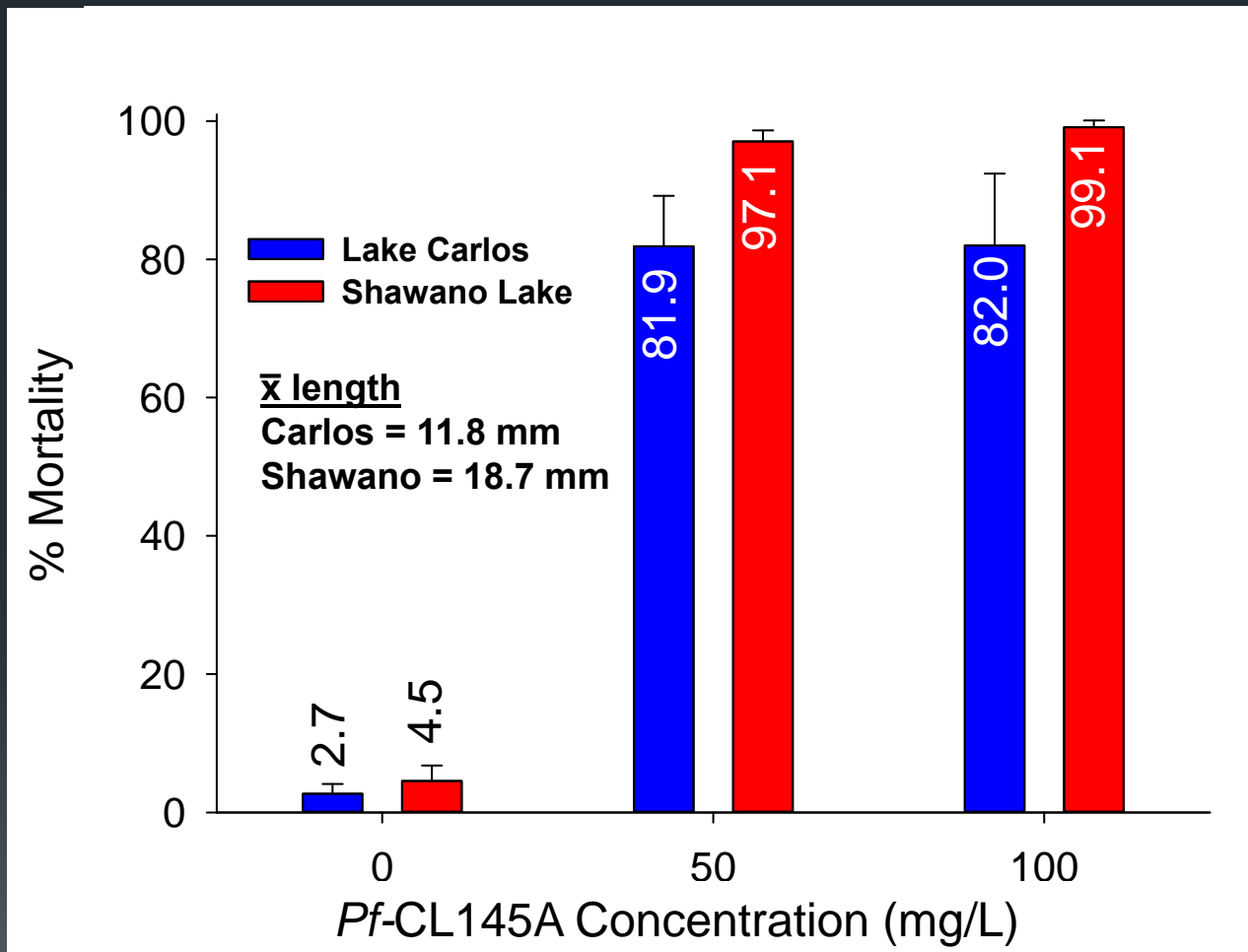
Whole Water Column Mortality

Lake Carlos

Shawano Lake



Injection Mortality



significant difference in LC 12-h treatment type WT vs. Inj. $P < 0.0001$

No significant difference in SL 12-h treatment type WT vs. Inj. $P = 0.1686$

2013 Planned Research

- Sub-adult native mussels will be exposed to Zequanox using procedures similar to those used in 2012 ZM testing
- Limited scope, in-lake application within enclosures at Keyes Lake, WI to native mussels with attached zebra mussels
- LCCMR project
 - Toxicity to aquatic insects
 - Fathead minnow reproduction
 - Limited in-lake applications in Lake Minnetonka



QUESTIONS?

