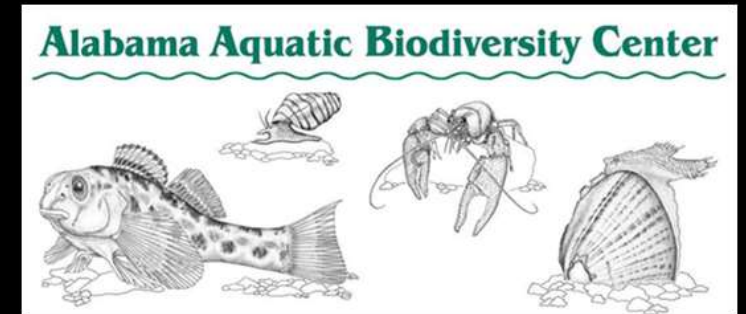


Acute Toxicity of Endemic Mollusk Species of the Mobile River Basin



Paul M. Stewart¹
Kesley J. Gibson¹
Jonathan M. Miller¹
Paul D. Johnson²

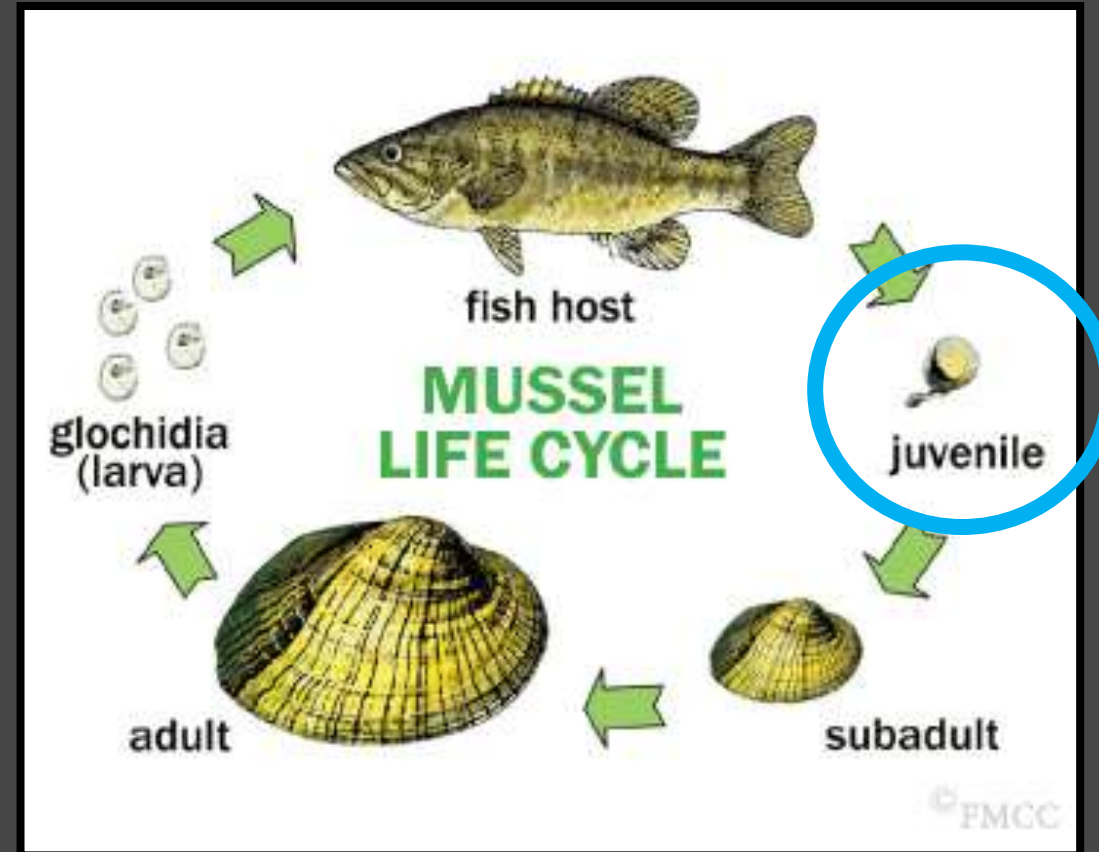


¹Troy University, Department of Biological and Environmental Sciences, Troy, AL 36082

²Alabama Aquatic Biodiversity Center, Marion, AL 36756

Freshwater Mussels

- Bivalvia
- Second most threatened fauna
 - 298 mussel taxa
- Extinction Rate
 - 1.2% per decade (since 1990)
 - 127 species over next 100 years
 - 6.4% per decade



http://fishwild.vt.edu/mussel/images/life_history/Colorized-Mussel-cycle_LG.gif

Freshwater Gastropods

- **Gastropoda**
- **Most threatened fauna**
 - 703 gastropod taxa
- **Extinction Rate**
 - 9.5% (65 species) extinct
 - 39.5% (278 species) endangered
 - 10.4% (73 species) threatened
- **M:BER of 10K**



Dr. Paul Johnson, AABC

Pollution

- Declines in freshwater mollusk populations attributed to human population growth and development
- Pollution the second leading cause
- ~500,000 river miles (13%) assessed
 - 36% impaired



Toxicity Testing

- **Important tool in protecting imperiled organisms**
 - **Aid in establishing USEPA Water Quality Criteria (WQC)**
- **Provides specific effects of toxicants on organisms**
 - **Reduced growth rate, reproduction rate, or death**
- **Demonstrates the cause-effect relationship between decline and stressor**

Water: Current Water Quality Criteria

Contact Us Share

You are here: Water » Science & Technology » Surface Water Standards & Guidance » Water Quality Standards » Water Quality Criteria » National Recommended Water Quality Criteria

National Recommended Water Quality Criteria

EPA's compilation of national recommended water quality criteria is presented as a summary table containing recommended water quality criteria for the protection of aquatic life and human health in surface water for approximately 150 pollutants. These criteria are published pursuant to Section 304(a) of the Clean Water Act (CWA) and provide guidance for states and tribes to use in adopting water quality standards.

Quick Navigation

- Previous versions of National Recommended Water Quality Criteria Table
- Chemical-specific criteria documents from the 1980s

Aquatic Life Criteria Table

Pollutant	CAS Number	P/NP*	Freshwater		Saltwater		Publication Year
			CMC ¹ (acute) (µg/L)	CCC ¹ (chronic) (µg/L)	CMC ¹ (acute) (µg/L)	CCC ¹ (chronic) (µg/L)	
Nickel	7440020	P	470 D, E	52 D, E	74 D	8.2 D	1995
Nonylphenol	84852153	NP	28ug/L	6.6ug/L	7ug/L	1.7ug/L	2005

What You Can Do

Aesthetic Qualities	—	NP	NARRATIVE STATEMENT—SEE DOCUMENT				1986
Aldrin	309002	P	3.0 G		1.3 G		1980
Alkalinity	—	NP		20000 C			1986

USEPA
WQC

Commonly Used Organisms in Toxicity Testing



Daphnia magna

http://mblaquaculture.com/assets/images/content/photo_Daphnia_magna.jpg



Fathead Minnow

<data:image/jpeg>



Diatoms

<http://www.daviddarling.info/images/diatoms.jpg>



Skeletonema

<http://media.nordicmicroalgae.org>



Physa sp.

<http://hbs.bishopmuseum.org/>



Rainbow Trout

<http://3.bp.blogspot.com>

Today we will discuss:

- **Acute Toxicity on Freshwater Mussel Species and Caenogastropod Species using**
 - **Sodium Dodecyl Sulfate (SDS)**
 - **Chloride (Cl) and Potassium (K)**
 - **Nickel (Ni) and Zinc (Zn)**

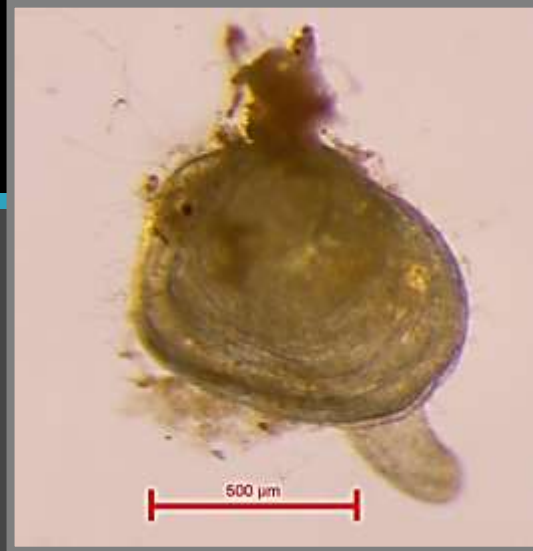
Mobile River Basin



- **High population of stenotypic species**
 - 40 fishes
 - 34 mussels
 - 10 species extinct
 - 105 gastropods
 - 37 species extinct



Villosa nebulosa
Petitioned



Hamiota perovalis
Threatened

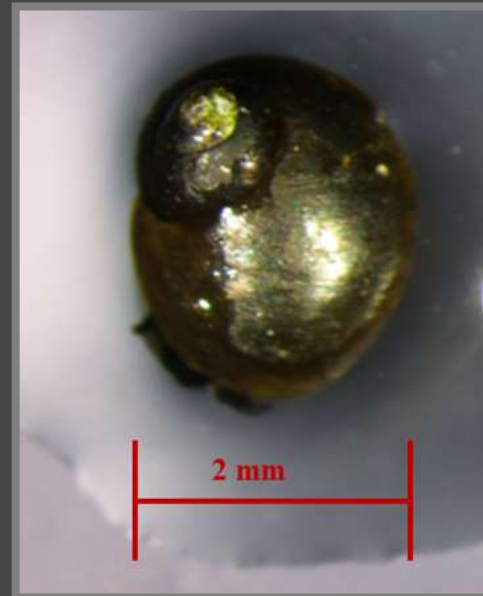


Villosa umbrans
Petitioned

Leptoxis ampla
Threatened



Somatogyrus sp.
Undescribed



Petition for Federal Protection



**PETITION TO LIST 404 AQUATIC, RIPARIAN AND WETLAND SPECIES FROM THE
SOUTHEASTERN UNITED STATES AS THREATENED OR ENDANGERED UNDER THE
ENDANGERED SPECIES ACT**

Center for Biological Diversity

April 20, 2010

USEPA WQC

Toxicants	Criteria Published Year	Limit	Mussels used?	Caenogastropod used?
SDS	None	N/A	N/A	N/A
Chloride	1988	860 mg/L	No	No
Potassium	None	N/A	N/A	N/A
Nickel	1995	470 µg/L	No	Yes
Zinc	1995	120 µg/L	No	Yes

Methods

Parameter	Test
Protocol	American Society for Testing and Materials (ASTM) E2455-06
Test Type	Static-renewal
Duration	96 hours
Light Quality	Ambient light
Photoperiod	16L:8D
Temperature	25 ± 1°C
Age of Organisms	Mussels: Juveniles (30-90 days) Gastropods: 5-8 months
Organisms/Chamber	10 individuals
Test Concentrations	5 concentrations + control
Replicates	3
Dilution Water	Soft water recipe from ASTM E729-96
Water Quality	Dissolved oxygen, pH, hardness, alkalinity, conductivity
Endpoint	Survival (Heartbeat or foot movement)
Test Acceptability	≥90% survival in controls
Data Analysis	LC ₅₀ using ToxStat [®] 3.5 (Trimmed Spearman-Kärber)

Survival Endpoint

Video credit: C. Barnhart

Heartbeat
or
foot movement





Acute Toxicity on Two Freshwater Mussel Species and Two Caenogastropod Species using Sodium Dodecyl Sulfate (SDS)

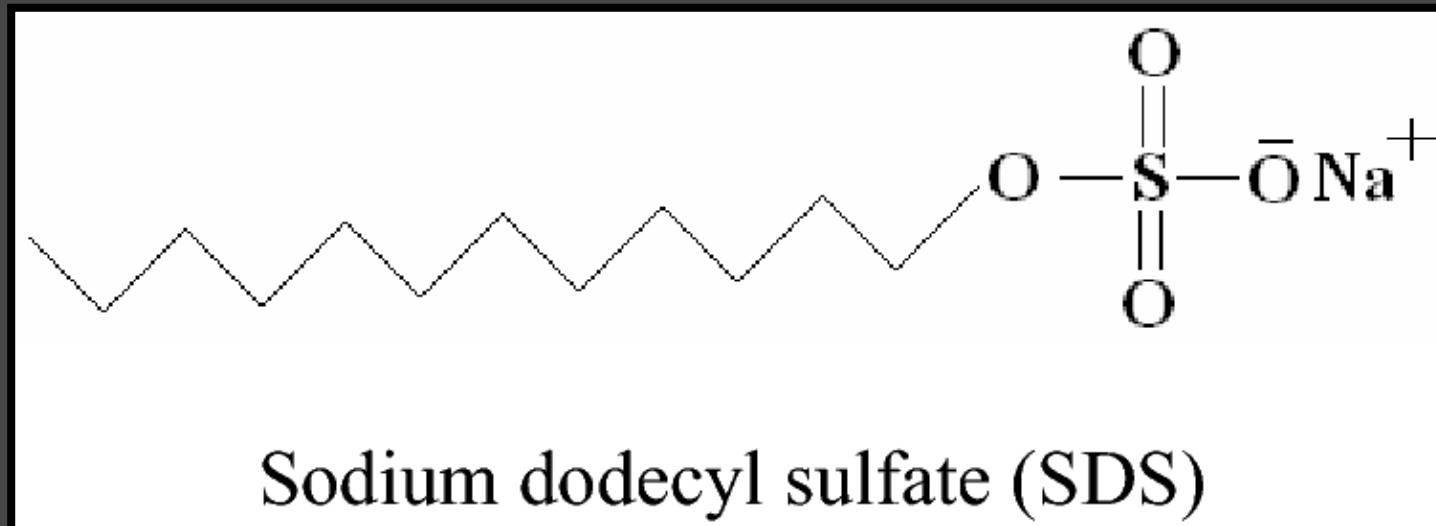
Objectives

- **Examine the sensitivity of two freshwater juvenile mussel species and two freshwater caenogastropod species to SDS**
- **Provide data that can be used in developing WQC for SDS**

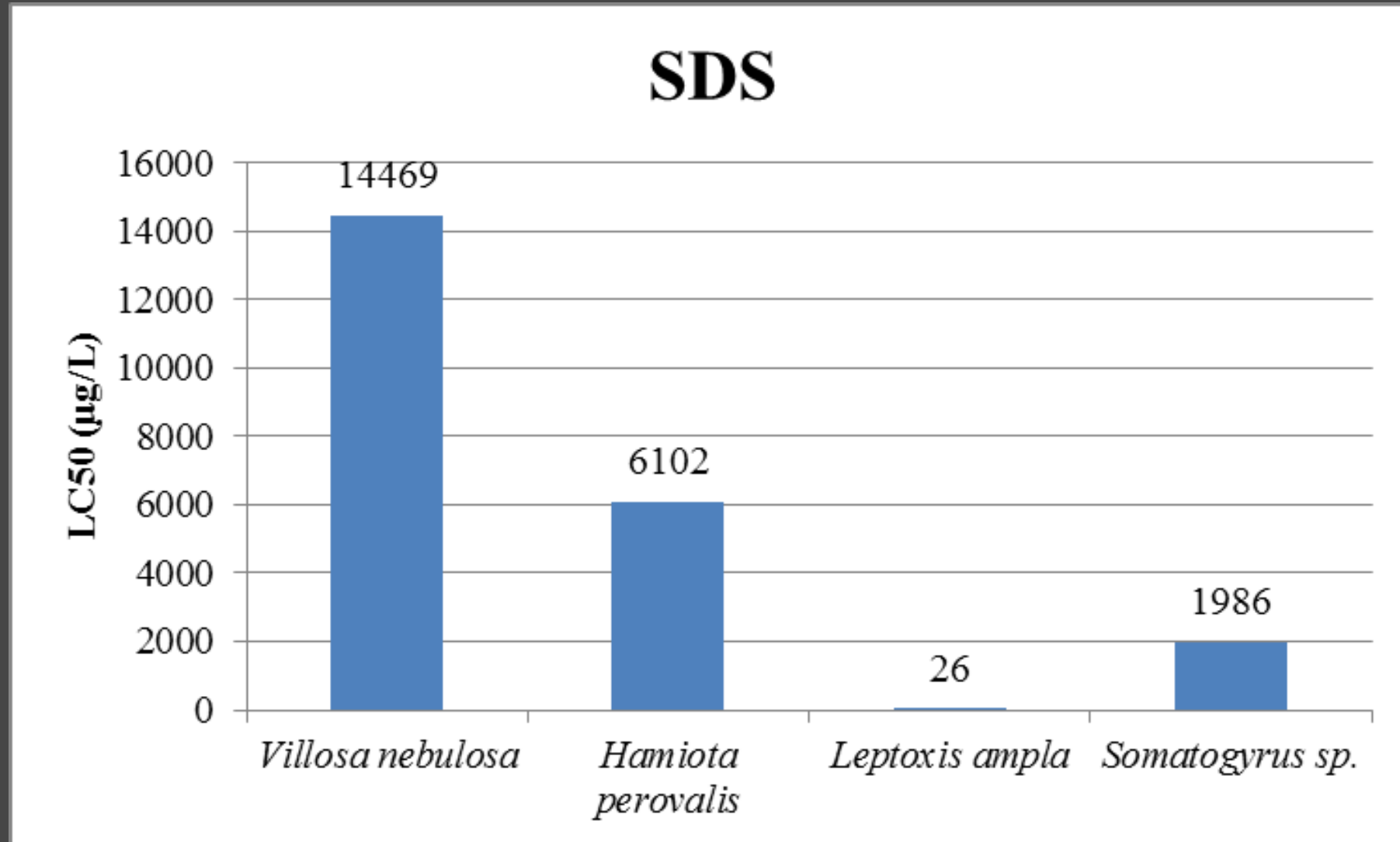


Sodium Dodecyl Sulfate (SDS)

- **Surfactant**
 - **Most widely used synthetic organic chemical**
 - **Detergents, shampoos, cosmetics, household cleaners, and dispersants used in oil-spill cleanup**



Results



Discussion

- Mussel LC_{50} values lower than other mussels tested using SDS
- Caenogastropod LC_{50} values much lower than mussels
 - *L. ampla* most sensitive species known
 - *Somatogyrus* sp. comparable to other studies





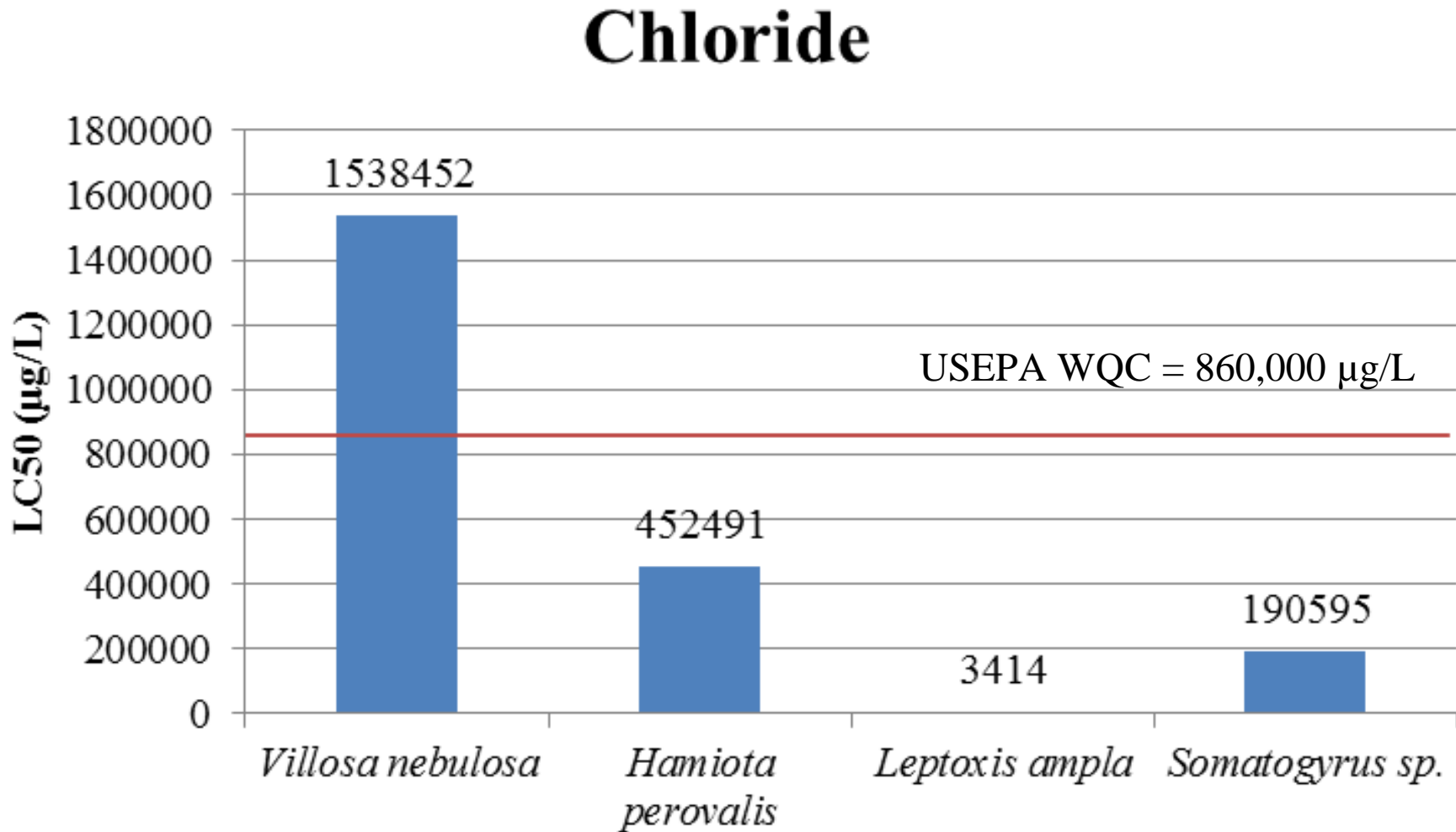
Acute Toxicity on Two Freshwater Mussel Species and Two Caenogastropod Species using Chloride (Cl) and Potassium (K)

Objectives

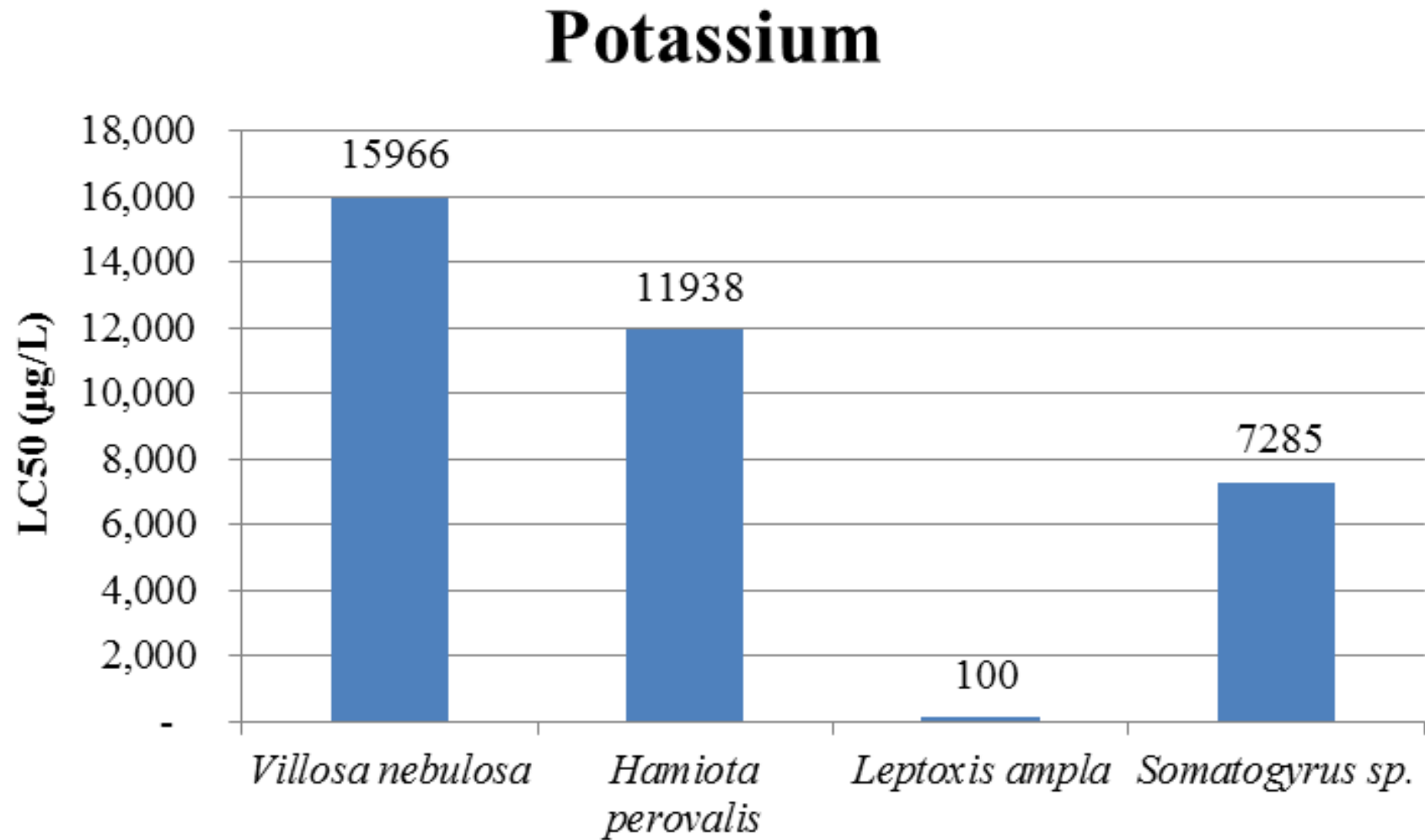
- **Examine the sensitivity of two freshwater juvenile mussel species and two freshwater caenogastropod species to Cl and K**
- **Provide data that can be used in reevaluating WQC for Cl and developing WQC for K**



Results



Results



Discussion

- **CI** – 3 of the 4 species had LC_{50} values below WQC
 - *Hamiota perovalis* - ~2x lower
 - *Somatogyrus* sp. - 4.5x lower
 - *Leptoxis ampla* - >250x lower
- **K** – Lower LC_{50} values than other species tested
 - Caenogastropods the most sensitive



http://chesapeakestormwater.net/wp-content/uploads/2012/01/road_salt00.jpg



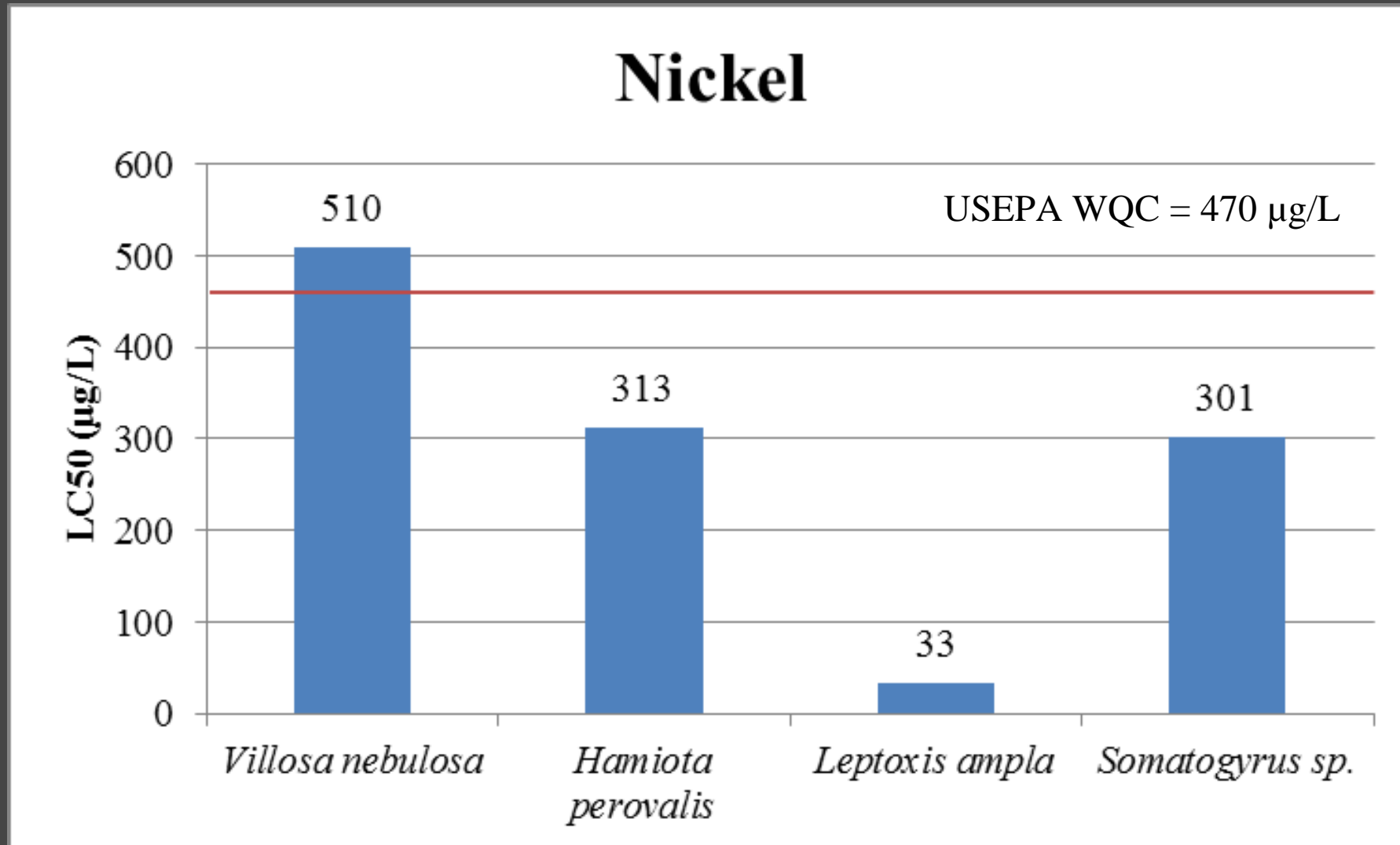
**Acute Toxicity on Three Freshwater Mussel Species and Two
Caenogastropod Species using Nickel (Ni) and Zinc (Zn)**

Objectives

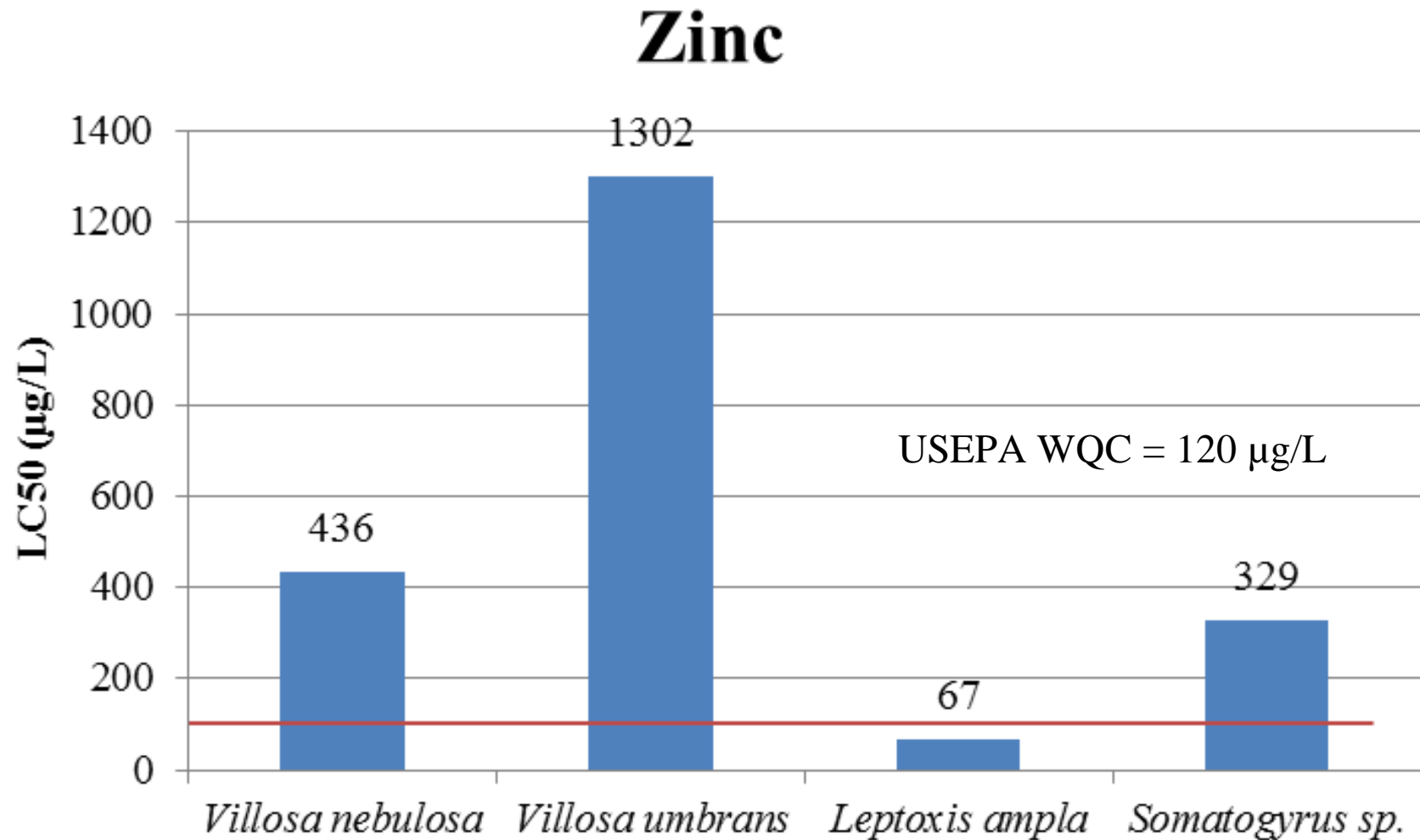
- **Examine the sensitivity of three freshwater juvenile mussel species and two freshwater caenogastropods species to Ni and Zn**
- **Provide data that can be used in reevaluating WQC for Ni and Zn**



Results



Results



Discussion

- **Ni** – Comparable to other mussel species, except *L. ampla*
 - 3 of 4 species below current WQC
- **Zn** – Comparable to other mussel species, except *L. ampla*
 - Only *L. ampla* below current WQC

Conclusions

- One of the few studies testing toxicity of these substances using freshwater mussels and gastropods
- **SDS** – Very toxic to *Leptoxis ampla*
- **Cl** – Current WQC not inclusive of sensitive species
- **K** – Sensitive species not protected
- **Ni** – Species may not be included/protected under current WQC
- **Zn** – *L. ampla* not included/protected under current WQC
- Regional criteria need to be developed protective of stenotypic species

Significance

- One of the few toxicity studies using threatened or species of concern
- Not been possible until recent advances in propagation and rearing techniques
 - AABC
- WQC not current and in need of updating to protect these imperiled species



Acknowledgements

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