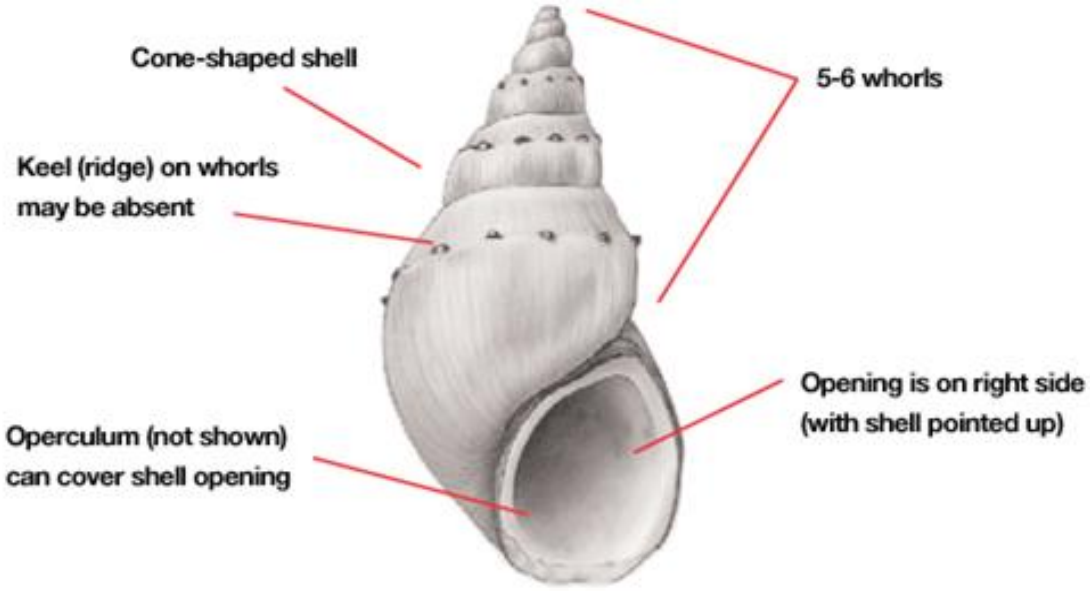
Status and Management Efforts of the New Zealand Mud Snail in the Great Lakes Region

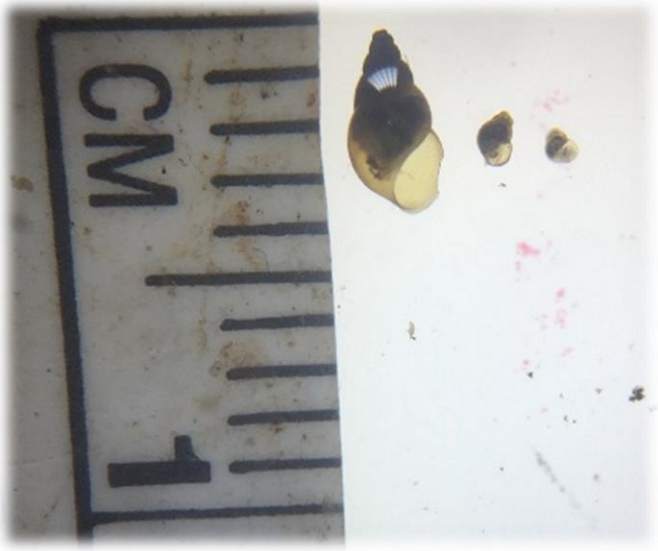
Jeremy Geist
Great Lakes Stream Restoration Manager
Trout Unlimited, Inc.
jeremy.geist@tu.org

TROUT UNLIMITED

Morphological Traits of the New Zealand Mud Snail (NZMS)

- Native to New Zealand
- Amber – brown coloration
- 4-6 mm (up to 12 mm in native range)
- 5-6 whorls
- Mid-keel ridge (some morphotypes)
- Dextral, operculate



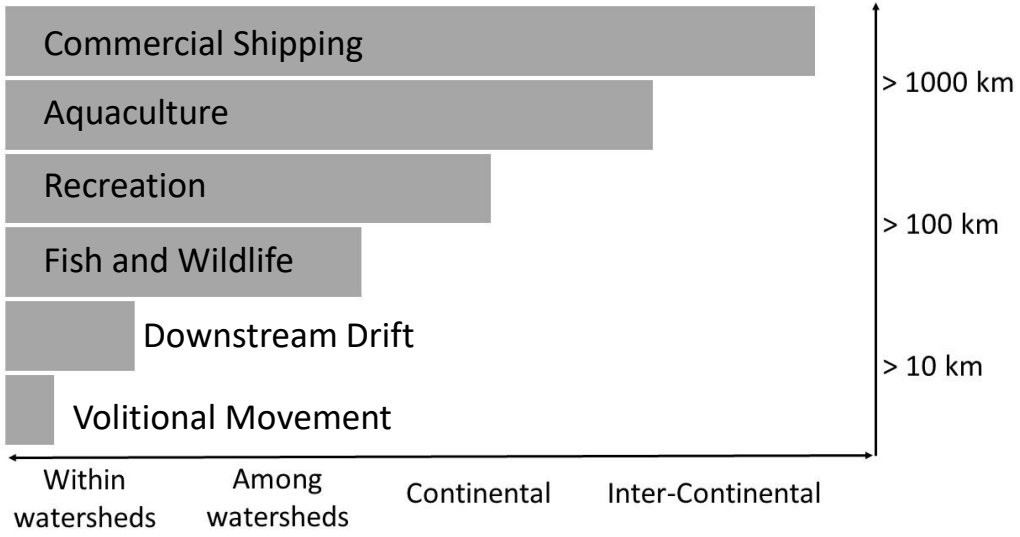


Life-History Traits of a Global Invader

- Herbivore/detritivores
- Rapid growth rate (sexual maturity at 3-3.5mm)
- Ovoviviparous
- Parthenogenic
- Highly fecund

Global Invader

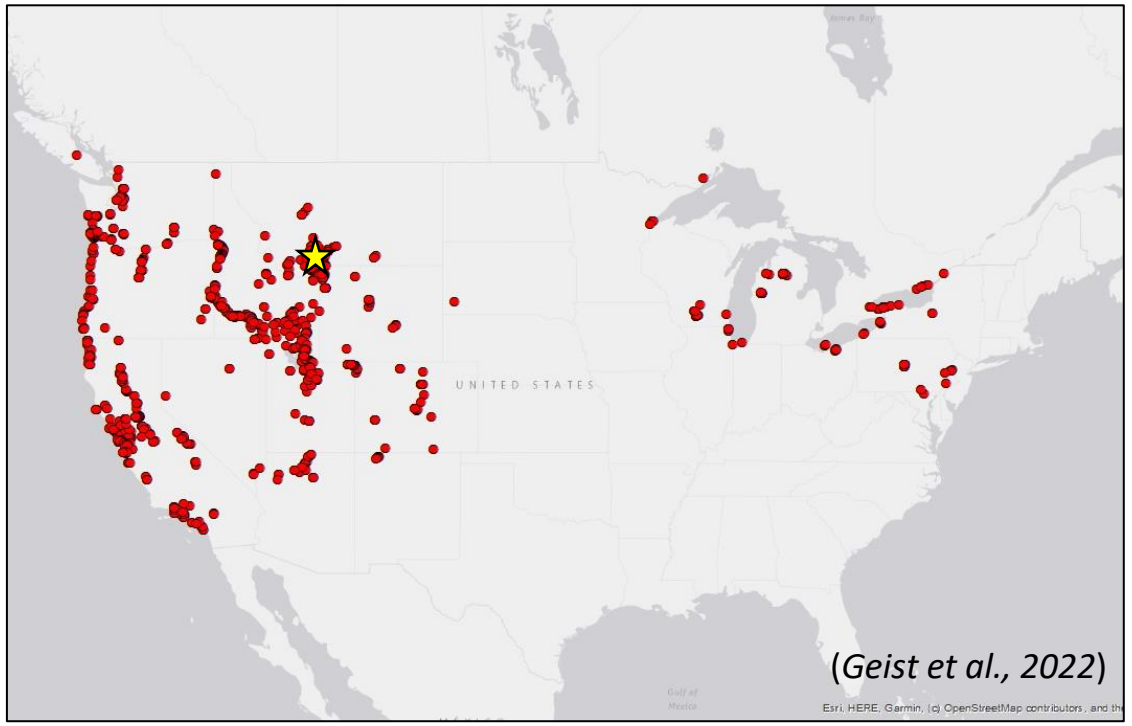
6 continents
40 countries
21 states (U.S.)



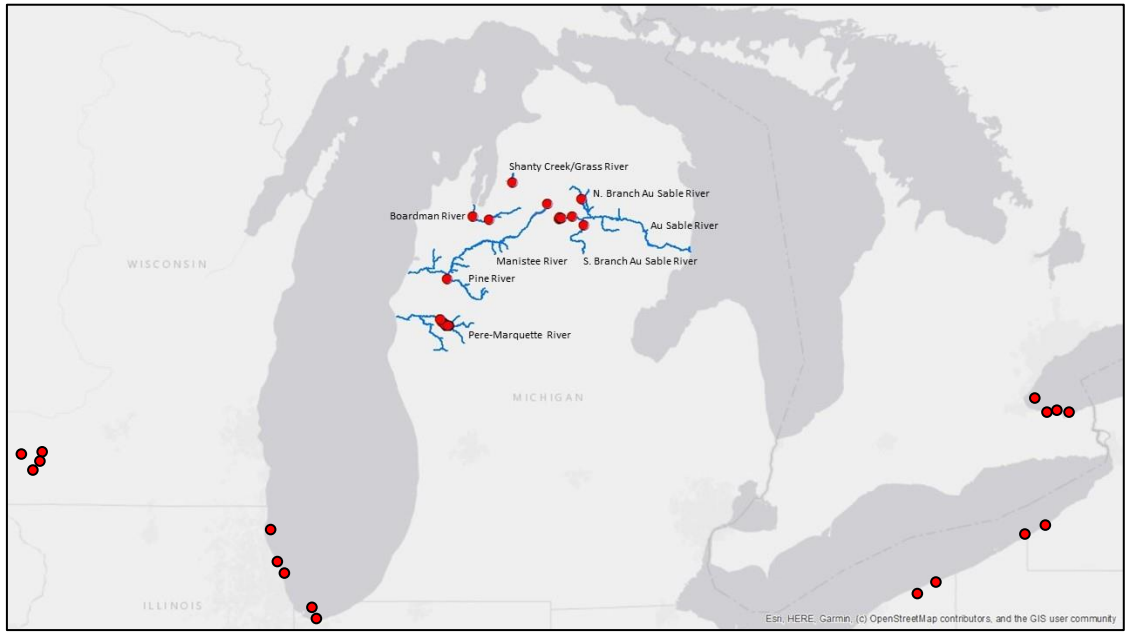
(*Geist et al., 2022*)

Spreading Across the U.S.

- 21 States
  - First discovery - 1987 (Snake River, ID)
- Great Lakes Region
  - First discovery - 1991 (Lake Ontario)
  - 4 Great Lakes
  - Inland streams and rivers 2008 (PA), 2012 (WI), 2015 (MI)



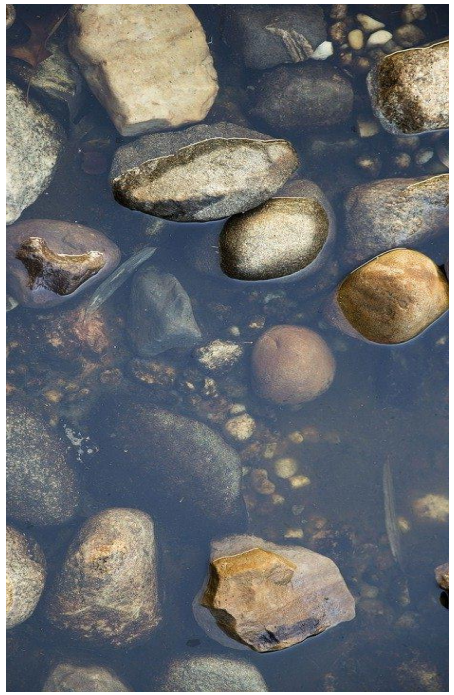
(*Geist et al., 2022*)



Habitat Suitability

- Occupy wide range of habitats
  - Streams, lakes, estuaries

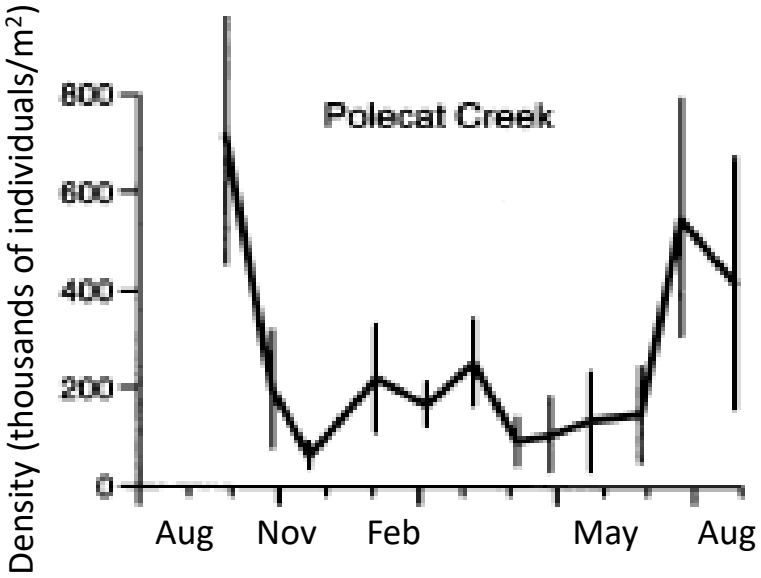
- Influenced by
  - Substrata
    - Interstitial space, subsurface
  - Hydrology (optimal)
    - Stable
    - Velocities ≤ 0.15 m/s
  - Physiochemical properties (optimal)
    - Temperature 17-18°F
    - Salinity 0 - 10 ppt
    - Conductivity > 200 µS/cm

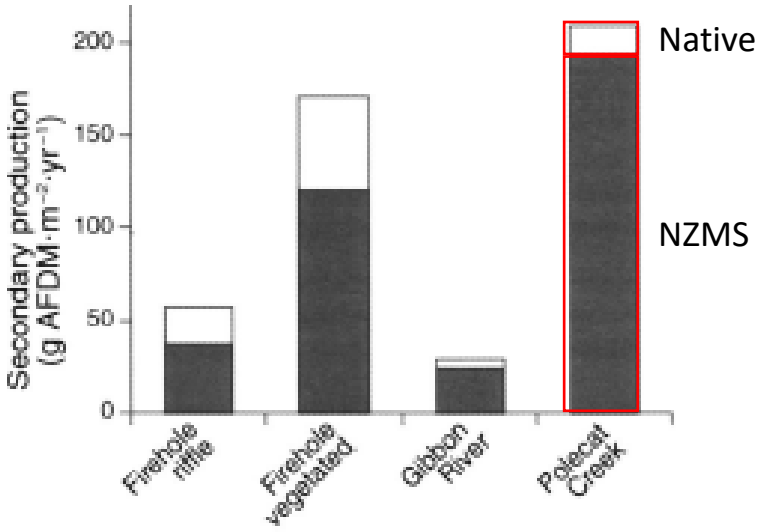


NZMS Impacts to Invaded Ecosystems

- Effects can vary
  - Clonal variants - behavior, invaded system attributes

- Known effects include
  - Extremely high densities and highest 2^{o} production reported
  - Alter composition of algal assemblages
  - Alter nutrient cycling
  - Compete with native grazers
  - Survives passage through gut tract, impacts on fish health





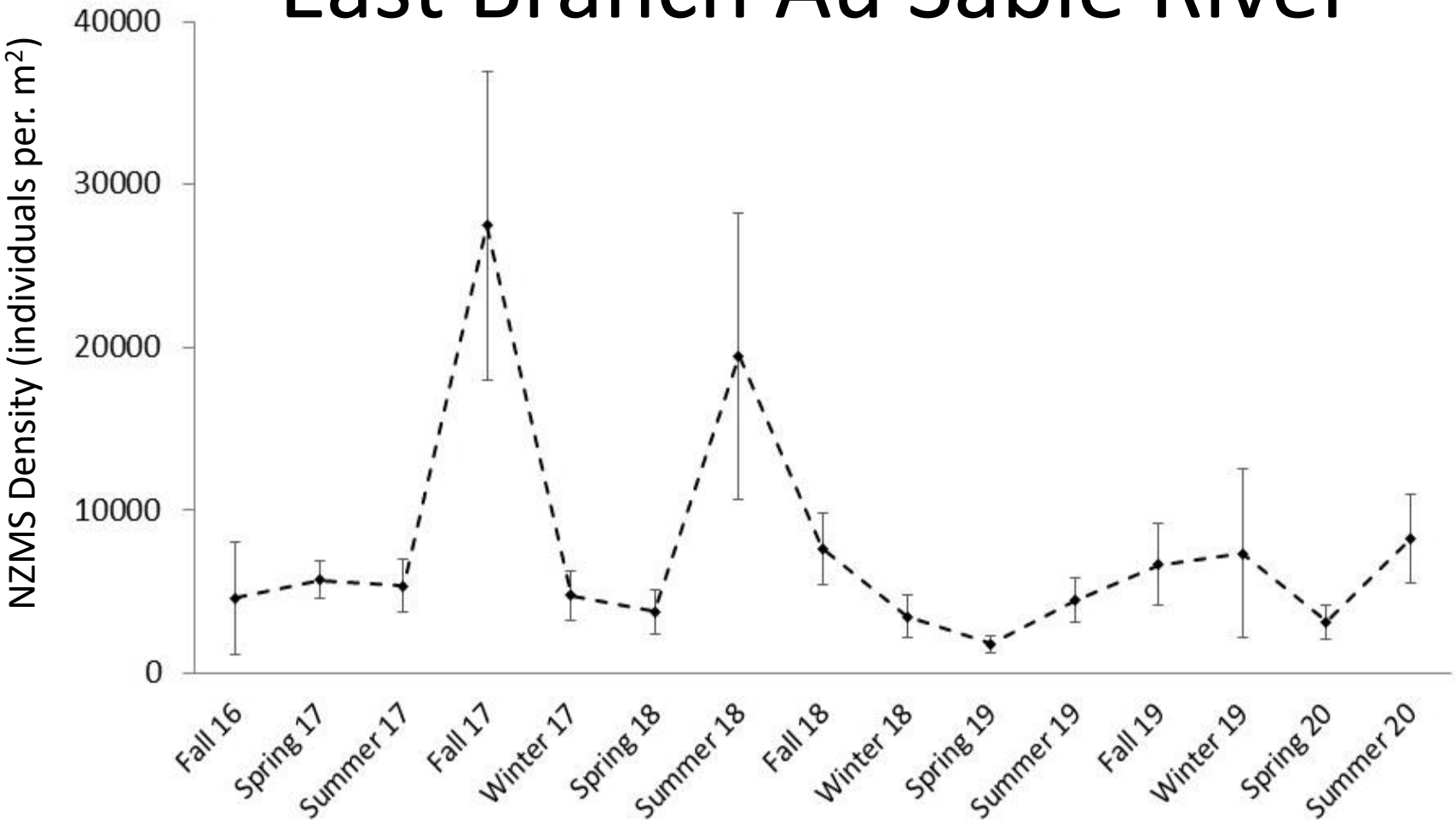
(Hall et al. 2006)

Boom-Bust Population Dynamics

(*Schrieber et al. 1998*)

(*Greenwood et al. 2020*)

NZMS Populations in the East Branch Au Sable River



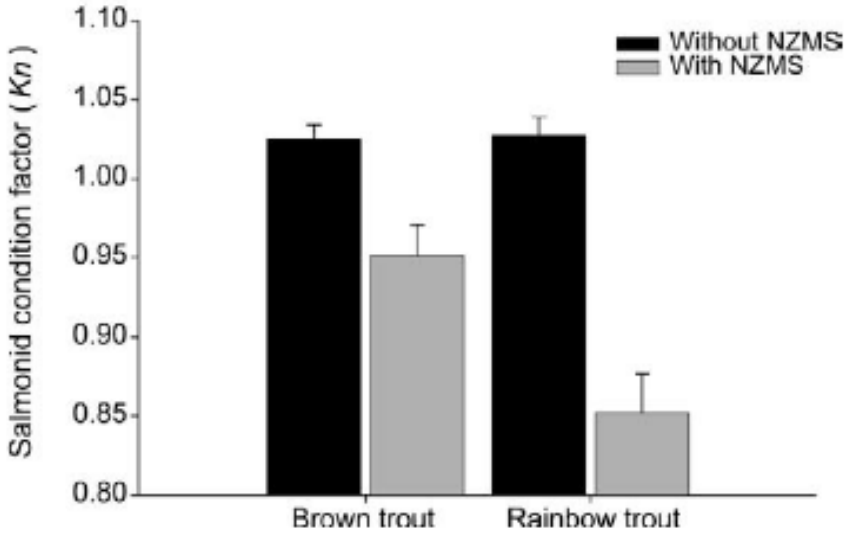
Mean NZMS densities for all sites combined across all seasons and years.
Error bars are ± SE.

NZMS as Prey

(*Rakauskus et al. 2016*)

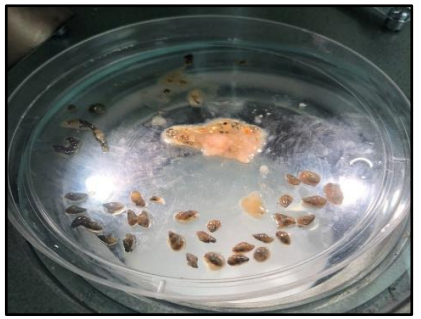
Species	I (ind.)	Undigested (%)	Survived (%)
P. fluviatilis	12.6 ± 5.1	99.6 ± 1.4	14.6 ± 15.1
R. rutilus	13.7 ± 4.2	76.1 ± 31.0	14.6 ± 21.4
P. glenii	8.6 ± 1.3	94.6 ± 13.4	44.6 ± 25.9
S. erythropthalmus	13.0 ± 5.6	95.8 ± 6.5	80.8 ± 20.8
N. melanostomus	22.7 ± 19.1	56.5 ± 33.7	7.9 ± 10.8
T. tinca	55.4 ± 35.5	1.1 ± 1.5	0 ± 0

- Can be consumed by fish but can survive the digestive process
- Hard shell (resistance to crushing)
- Low tissue/shell mass ratio
- Shown to affect trout health in other invaded regions

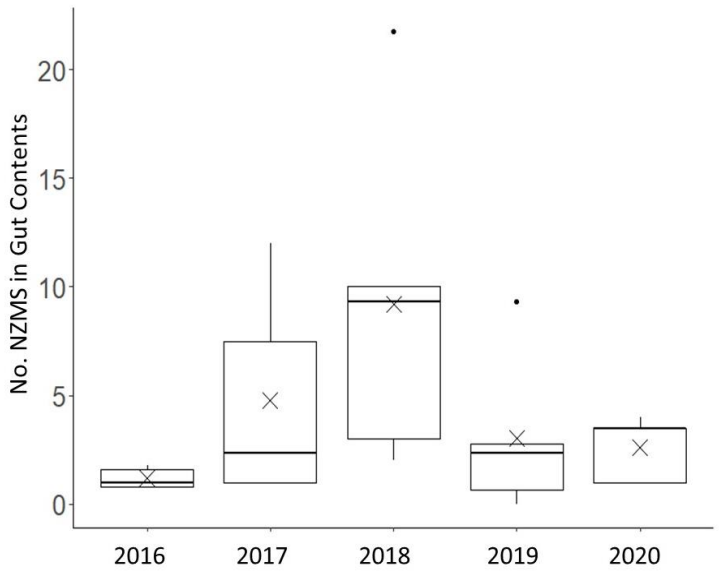


Vinson and Baker 2008

Trout Consume NZMS In Michigan



- 60% of all sampled trout had NZMS in gut contents
- Most trout consumed < 10 NZMS, others more
- Feeding on NZMS varies over time; generally, tracks NZMS densities in the stream



(*Geist et al. 2022, in prep*)

Great Lakes New Zealand Mud Snail Collaborative

END THE SPREAD
New Zealand Mud Snails

- Prompt:
  - Increased NZMS detections (e.g., streams and rivers)
  - Overlap in high quality cold-water systems
  - Potential impacts
- Established 2017 (GLRI – EPA)
- Working group made up of
  - NGO's
  - State/Federal agencies
  - Universities
  - Anyone interested

Great Lakes RESTORATION

TROUT UNLIMITED

OAKLAND UNIVERSITY

GRAND VALLEY STATE UNIVERSITY

MICHIGAN STATE UNIVERSITY

DEPARTMENT OF NATURAL RESOURCES DNR MICHIGAN

EGLE
MICHIGAN DEPARTMENT OF ENVIRONMENT, GREAT LAKES, AND ENERGY

WI DNR

Sea Grant
University of Wisconsin

Great Lakes Commission
des Grands Lacs

Great Lakes New Zealand Mud Snail Collaborative

Goals:

I. Improve understanding on the current and future status of NZMS in the Great Lakes and tributaries.

II. Assist in regional management strategies and actions.

III. Minimize spread of NZMS in the Great Lakes Region.

IV. Increase awareness and education on NZMS related issues to the public.

END THE SPREAD
New Zealand Mud Snails

Great Lakes New Zealand Mud Snail Collaborative

- Great Lakes NZMS Collaborative website: www.nzmscollaborative.org
  - Clearing house for NZMS related information
  - NZMS survey efforts and distribution
  - Spread prevention/decontamination

- Status/review paper

Biol Invasions
https://doi.org/10.1007/s10530-021-02681-7

Check for updates

REVIEW

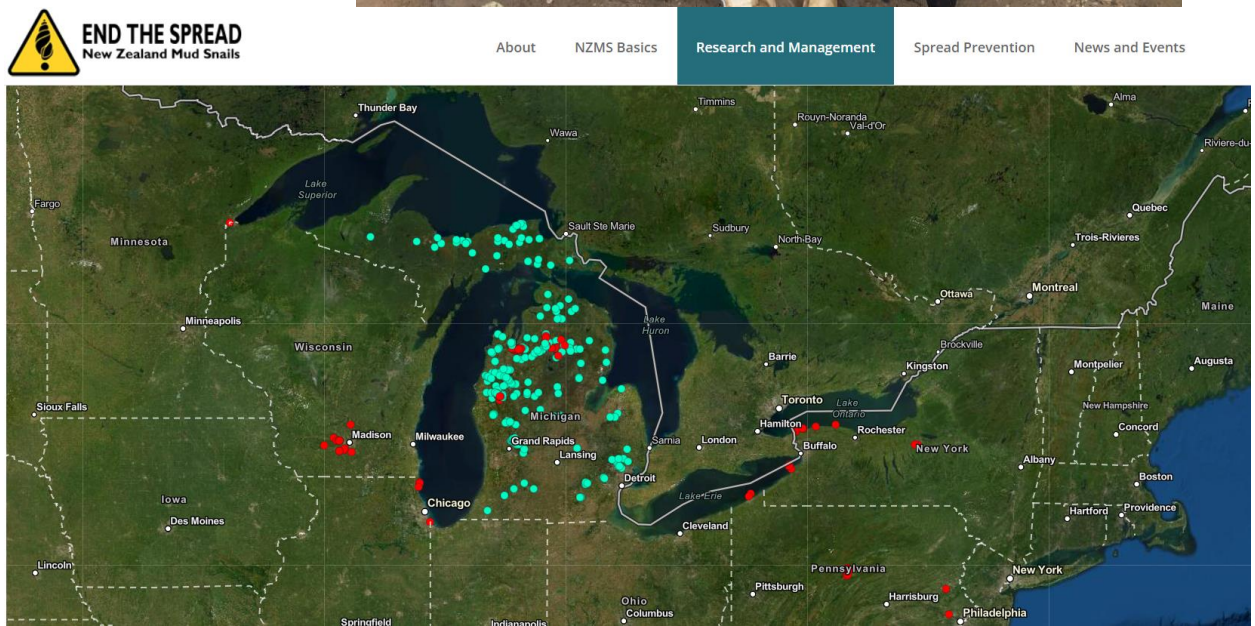
The New Zealand mud snail (*Potamopyrgus antipodarum*): autecology and management of a global invader

Jeremy A. Geist · Jasmine L. Mancuso · Morgan M. Morin · Kennedy P. Bommarito · Emily N. Bovee · Doug Wendell · Bryan Burroughs · Mark R. Luttenton · David L. Strayer · Scott D. Tiegs

Received: 16 April 2021 / Accepted: 15 November 2021

Great Lakes New Zealand Mud Snail Collaborative

- Collaborate/assist in regional monitoring and strategies
- Help develop clearing house of NZMS occurrence data in the GL region



Great Lakes New Zealand Mud Snail Collaborative

- Help minimize spread of NZMS
- Public education and the evaluation of effective recreational (i.e., angling) gear decontamination strategies.

Spread through Recreational Fishing

- NZMS invaded range often overlaps with popular fishing destinations

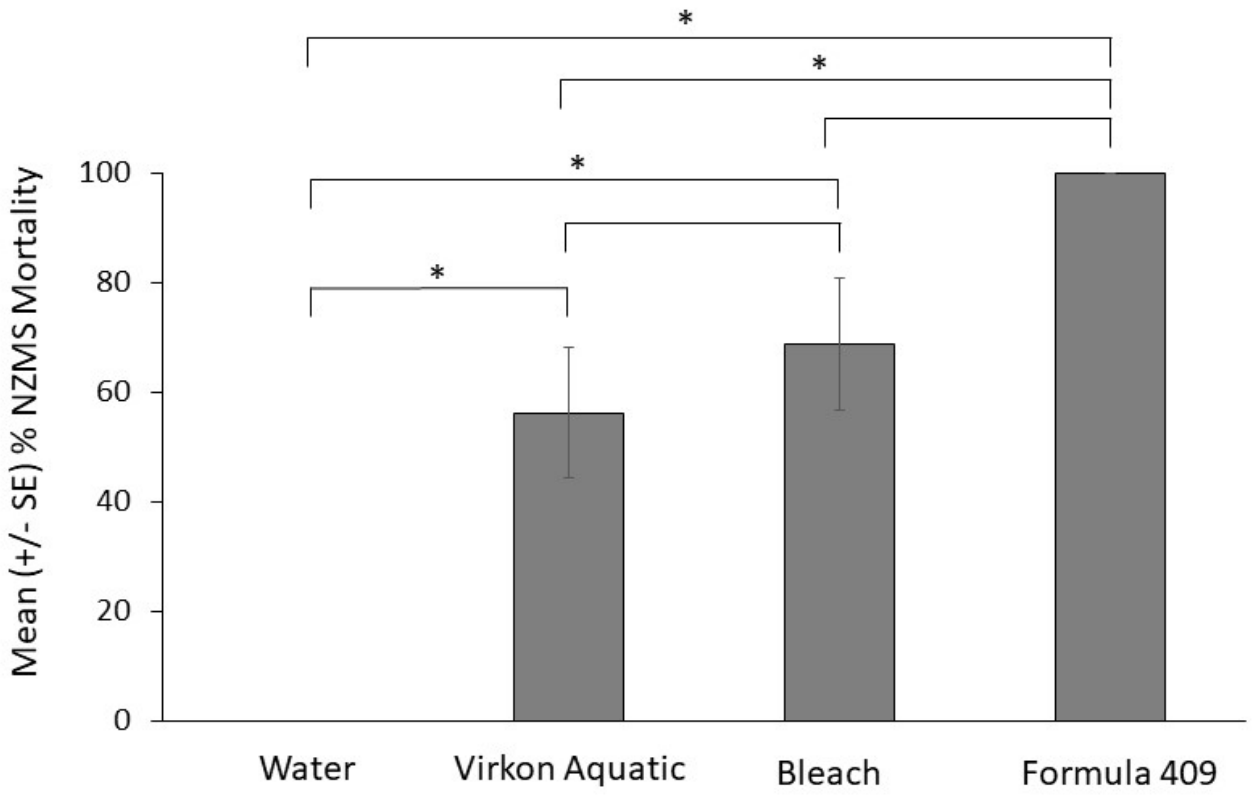
- NZMS attachment to fishing gear (i.e., waders and boots) are a means of NZMS spread within and among watersheds

Effective and Practical Decontamination Strategies are Needed

- Various decontaminants have been evaluated
- Contrast in results
- Many chemical reagents difficult for general public to acquire and apply

Decontaminants Vary in Effectiveness

- NZMS mortality differs among decontaminants
- Formula 409 most effective
- Neither exposure duration nor application method influenced NZMS mortality



(*Geist et al, 2022, N. Amer. Journal of Fisheries Management*)

Anglers Most Likely to Spray Formula 409

- Anglers most willing to use Formula 409 by spray
- Least willing to use bleach
- Not likely to soak waders/gear in any decontaminant

Likert-type scale of 1-7 (1 = not likely, 7 = very likely).

Treatment Combination	Mean Response	Median Response	Mode	n
Virkon Aquatic:Spray:10-min	3.75	4	1	338
Virkon Aquatic:Spray:20-min	3.64	4	1	338
Formula 409:Spray:10-min	4.39	5	7	335
Formula 409:Spray:20-min	4.35	5	7	334
Bleach:Spray:10-min	3.18	3	1	331
Bleach:Spray:20-min	3.06	2	1	332
Virkon Aquatic:Soak:10-min	2.10	1	1	334
Virkon Aquatic:Soak:20-min	2.03	1	1	332
Formula 409:Soak:10-min	2.23	1	1	332
Formula 409:Soak:20-min	2.19	1	1	332
Bleach:Soak:10-min	2.05	1	1	330
Bleach:Soak:20-min	2.02	1	1	333

(*Geist et al. 2022, N. Amer. Journal of Fisheries Management*)

Coupling Decontamination Trials and Angler Survey

Likert-type scale of 1-7 (1 = not likely, 7 = very likely).

Decontamination Strategy	Mean NZMS Mortality (%M [Decimal])	Survey Median Response (SMR)	Angler Decontamination Metric (ADM = %M*SMR)
409:Spray:10-min	1	5	5
409:Spray:20-min	1	5	5
Virkon:Spray:10-min	0.5	4	2
Bleach:Spray:10-min	0.5	3	1.5
Bleach:Spray:20-min	0.75	2	1.5
409:Soak:10-min	1	1	1
409:Soak:20-min	1	1	1
Bleach:Soak:10-min	1	1	1
Virkon:Spray:20-min	0.25	4	1
Virkon:Soak:10-min	0.75	1	0.75
Virkon:Soak:20-min	0.75	1	0.75
Bleach:Soak:20-min	0.5	1	0.5

- Develop recommendation for NZMS Decontamination using Formula 409 by spraying (at least 10-min)

(*Geist et al. 2022, N. Amer. Journal of Fisheries Management*)

Great Lakes New Zealand Mud Snail Collaborative

Increase awareness and education on NZMS related issues to the public.

- Educational signage/pamphlets/videos
- Public outreach/presentations
- Webinars

A CASE FOR THE GREAT LAKES

Produced by the Trout Unlimited NLC Great Lakes Workgroup

Trout Unlimited

Oakland University – Michigan Invasive Species Grant Program

University of WI Sea Grant – Great Lakes Restoration Initiative

Looking Ahead

- Continue to share current/ongoing research, monitoring and management efforts
- Disseminate information/educational resources across the region
- Collaboration/planning with National NZMS Task Force (NZMS Mgmt Plan 2023)

Acknowledgements

- Jim Amrhein, Wisconsin Department of Natural Resources
- Bryan Burroughs, Michigan Trout Unlimited
- Tim Campbell, University of Wisconsin Sea Grant
- Maureen Ferry, Wisconsin Department of Natural Resources
- Daniel Hayes, Michigan State University
- Seth Herbst, Michigan Department of Natural Resources
- Sarah LeSage, Michigan Department of Environment, Great Lakes and Energy
- Mark Luttenton, Grand Valley State University
- Lucas Nathan, Michigan Department of Natural Resources
- Samantha Tank, Michigan State Univ./Great Lakes Commission
- Kristin Thomas, Michigan Trout Unlimited
- Theresa Thom, U.S. Fish and Wildlife Service
- Scott Tiegs, Oakland University
- Many more.

Questions?

Jeremy Geist, PhD | Great Lakes Stream Restoration Manager
jeremy.geist@tu.org