

Integrating Freshwater Mussels with Chesapeake Bay Restoration

STAC Workshop, March 5-6, 2020, Annapolis MD



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Tom Ihde, MSU/STAC, Danielle Kreeger, Partnership for the Delaware Estuary, Rachel Mair, USFWS,
Shawn McLaughlin, NOAA, Simeon Hahn, NOAA**

•Presenters:

- Dave Strayer (Cary Institute of Ecosystem Studies)
- Carla Atkinson (University of Alabama)
- Danielle Kreeger (Partnership for Delaware Estuary)
- Bob Anderson (USWFS)
- Jeff Cornwell (University of Maryland, Center for Environmental Studies)
- Rachel Mair (USFWS)
- Simeon Hahn (NOAA)

•Attendees

- All watershed States and the District
- ~20 Local, State and Federal agencies
- Mussel biologist from throughout the watershed
- Representation from various GITs, CBP and planning groups

•Completed report expected March-April 2021



The top 10 reasons the Chesapeake Bay Partnership should pay closer attention to mussels...



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The top 10 reasons the Chesapeake Bay Partnership should pay closer attention to mussels

10. Most people don't know much about freshwater mussels...



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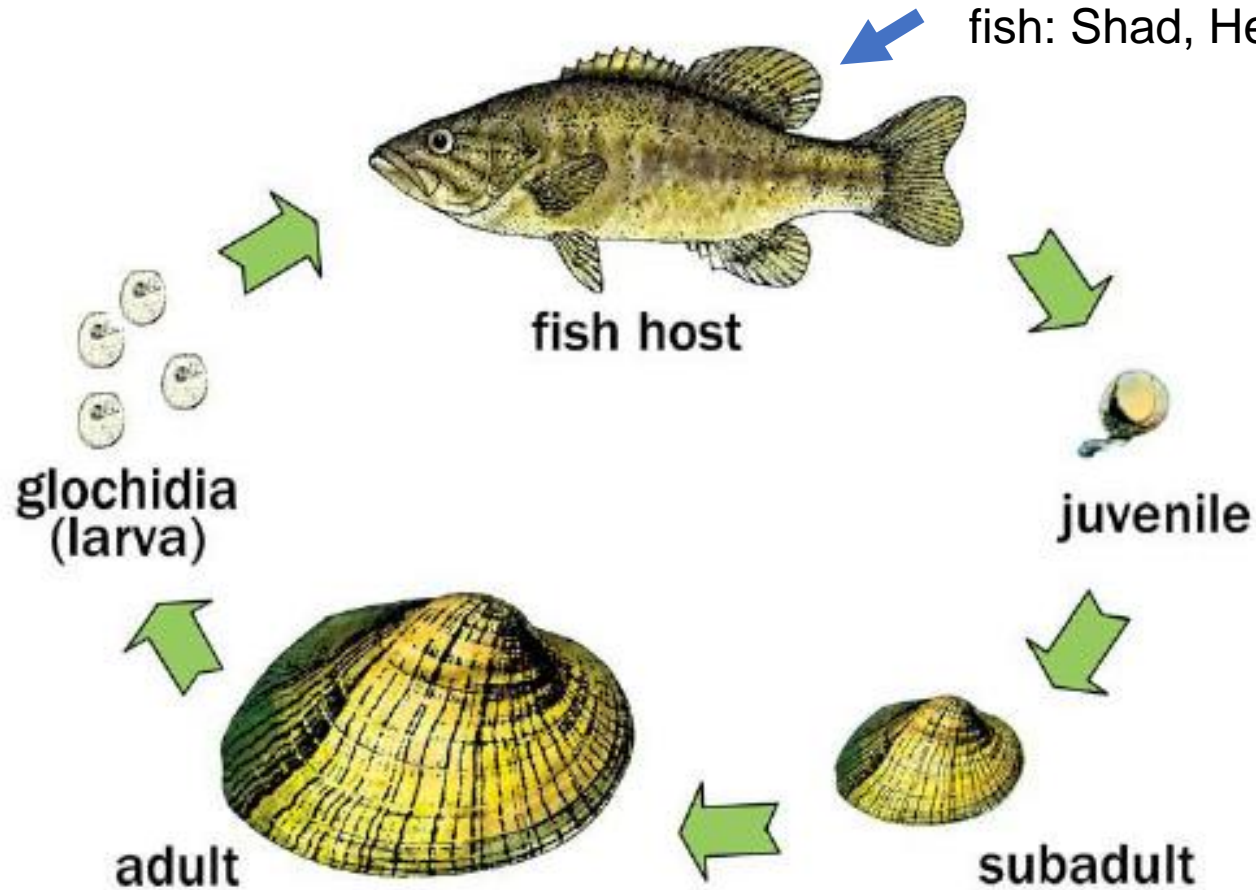
TOP 10 Reasons Mussels should be a priority for
the Chesapeake Bay Partnership



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What is going on here...

Often anadromous
fish: Shad, Herring



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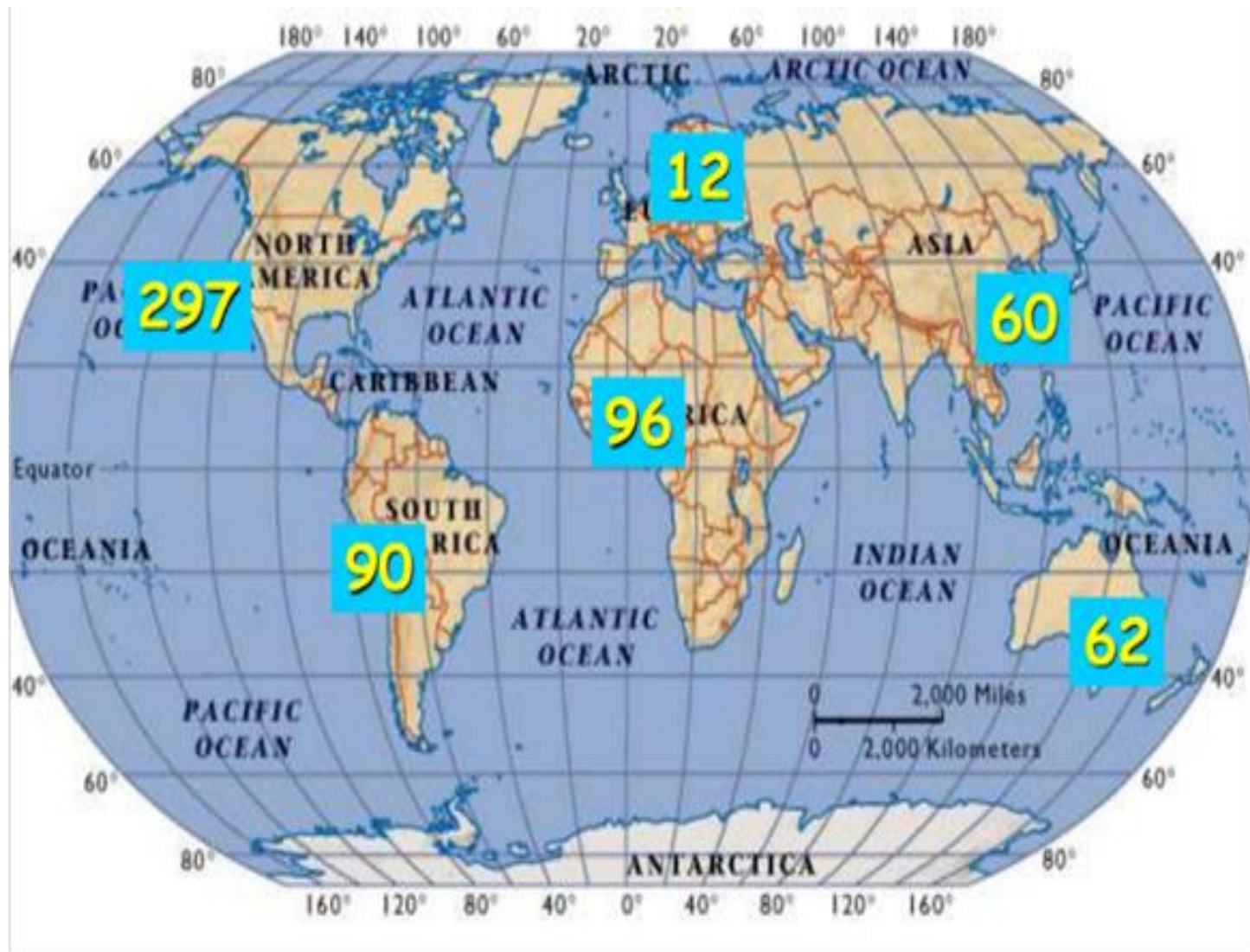
Freshwater Mussel reproductive cycle

9. The Chesapeake Bay Watershed has tremendous mussel biodiversity.



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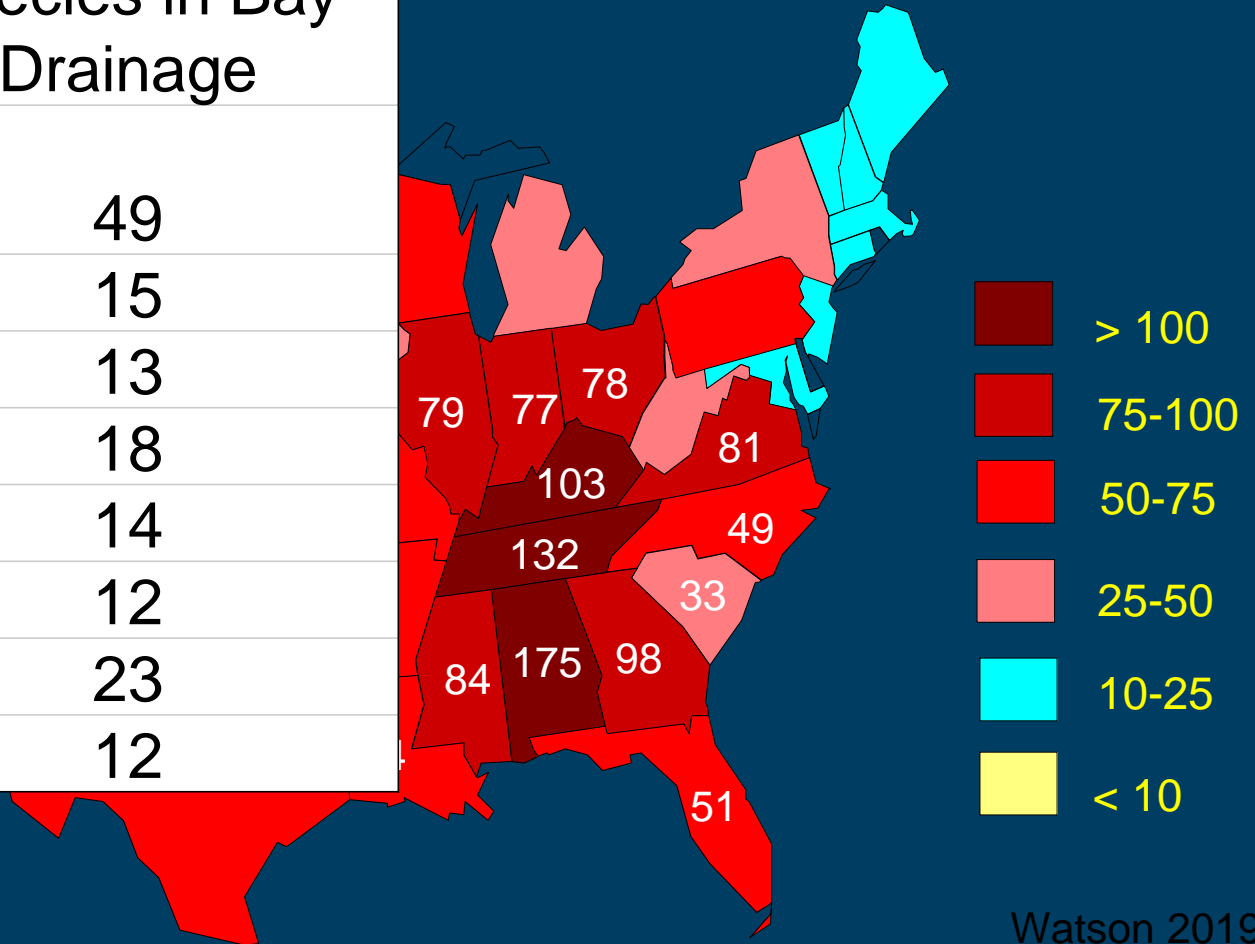


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North America is the hub of biodiversity for
freshwater mussels

Number of mussel species by state;

Geography:	Species in Bay Drainage
Baywide	49
DC	15
DE	13
MD	18
NY	14
PA	12
VA	23
WV	12



8. Mussels sometimes represent the most sensitive form of aquatic life and can be a focal point for water quality standards; Mussels can be a valuable bio indicators for water quality.



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**TOP 10 Reasons Mussels should be a priority for
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\$528,379, calculated from the prior collection approved by OMB.

John Moses,

Director, Collection Strategies Division.

[FR Doc. 2013-20458 Filed 8-21-13; 8:45 am]

BILLING CODE 6560-50-P

ENVIRONMENTAL PROTECTION AGENCY

[EPA-HQ-OW-2009-0921; FRL-9810-4]

Final Aquatic Life Ambient Water Quality Criteria For Ammonia—Freshwater 2013

AGENCY: Environmental Protection Agency (EPA).

ACTION: Notice of availability of final criteria.

SUMMARY: Pursuant to section 304(a) of the Clean Water Act (CWA), the Environmental Protection Agency (EPA) is announcing the availability of final national recommended ambient water quality criteria for the protection of aquatic life from effects of ammonia in freshwater (EPA 822-R-13-001). The final criteria incorporate the latest scientific knowledge on the toxicity of ammonia to freshwater aquatic life. On December 30, 2009, EPA published draft

identified by Docket ID No. EPA-HQ-OW-2009-0921. They may be accessed online at:

- www.regulations.gov: Follow the on-line instructions.
- **Email:** OW-Docket@epa.gov.
- **Mail:** US Environmental Protection Agency; EPA Docket Center (EPA/DC) Water Docket, MC 2822T; 1200 Pennsylvania Avenue NW., Washington, DC 20460.



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Fracking Chemicals Dumped in Allegheny River a Decade Ago Still Showing Up in Mussels

New study shows that strontium is making its way into the food chain

KRISTINA MARUSIC

epa.gov.

SUPPLEMENTARY INFORMATION:

1. What are water quality criteria?

Ammonia can enter the aquatic environment via direct means such as municipal effluent discharges and the



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EPA finalized ammonia criteria for freshwater mussels in 2013; that apply broadly across the Bay watershed

7. Mussels are shellfish, and the partnership has committed to protecting these organisms.



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FISHERIES GOAL: Protect, restore and enhance finfish, shellfish and other living resources, their habitats and ecological relationships to sustain all fisheries and provide for a balanced ecosystem in the watershed and Bay



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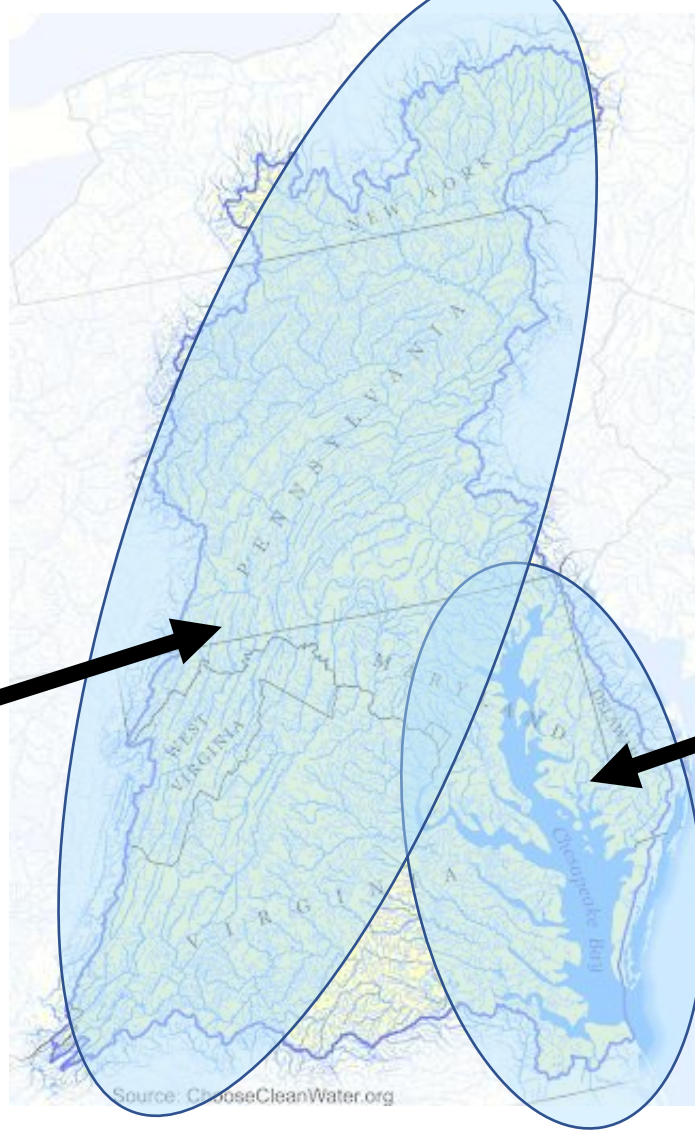
6. Mussels live in freshwater portions of the watersheds where engagement is especially important.



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What's in my back yard?



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You have a better chance of having a mussel
habitat in your backyard than crabs, oysters or
striped bass

5. Mussels provide ecosystem services by filtering water and can enhance denitrification.



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Freshwater Mussels = Important Functions

Filter feeding

Nutrient release

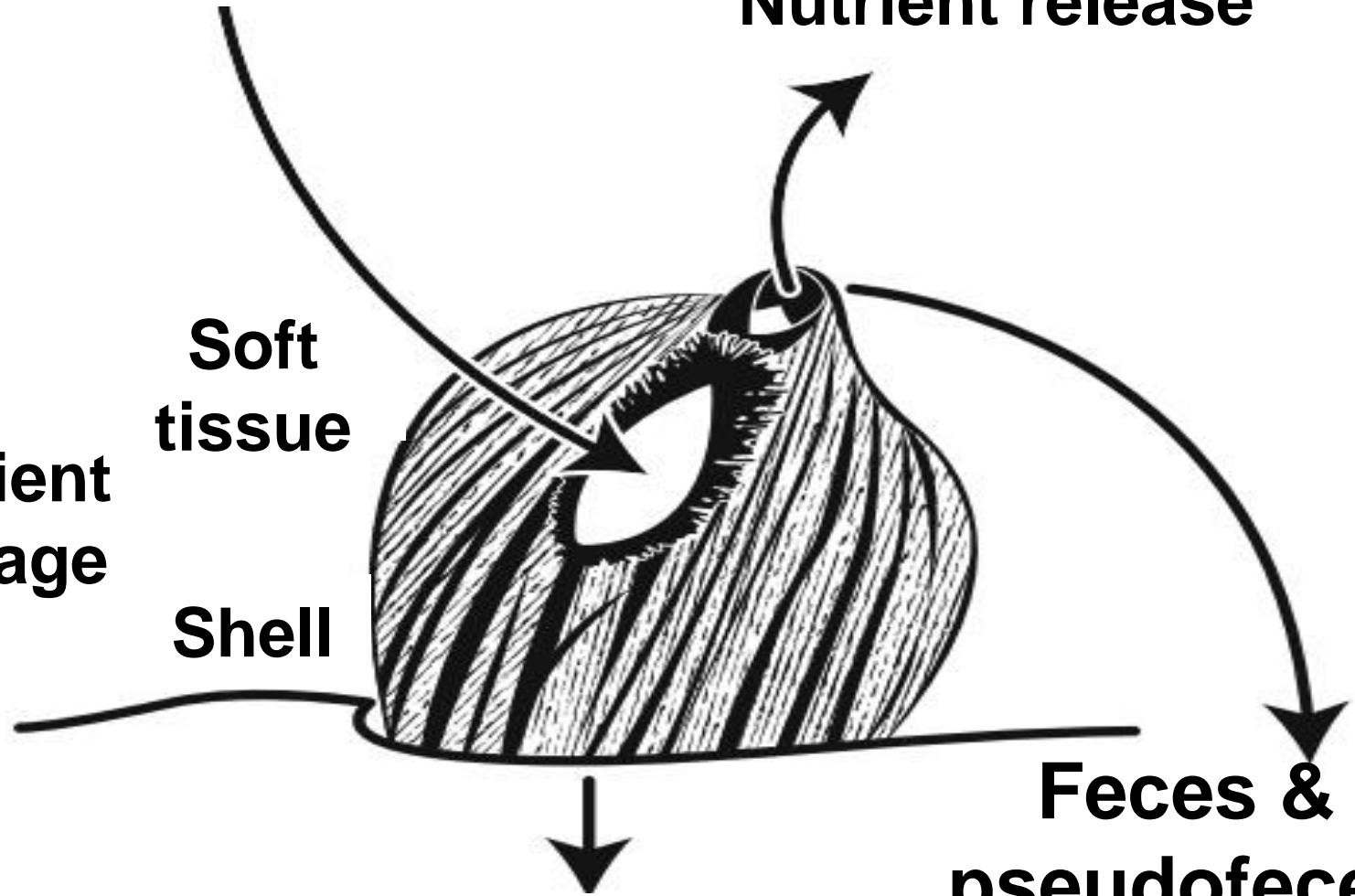
**Soft
tissue**

**Nutrient
Storage**

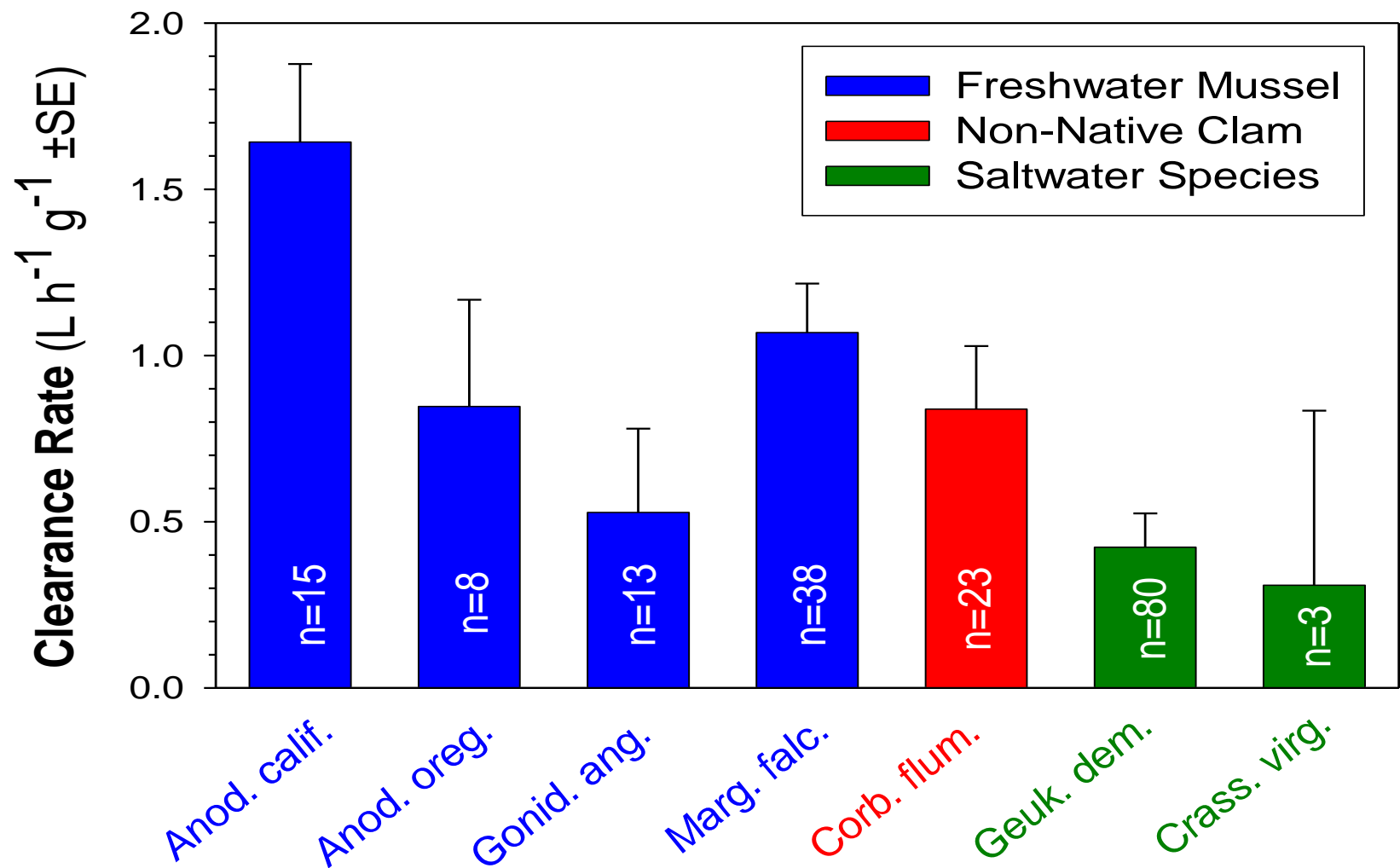
Shell

**Feces &
pseudofeces**

Burrowing



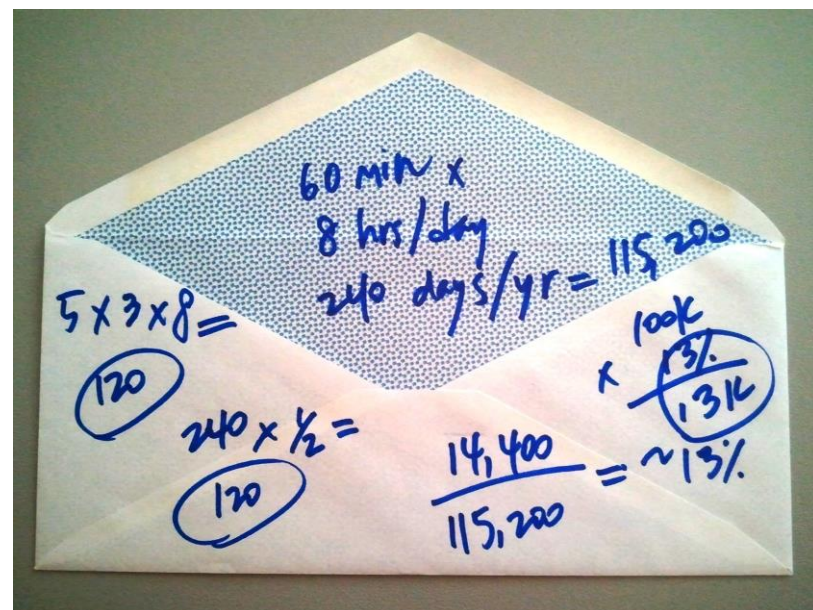
Modified from Vaughn & Hakencamp 2001



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Mussels filter water like oysters- and enhance denitrification (remove N to atmosphere)

Freshwater mussel densities of 1-10 individual per m² across the Susquehanna watershed would correspond to net denitrification effects ranging from 39,615 lbs. to 18.2 million lbs. nitrogen per year. This corresponds to 0.1% to 12.7% of current nitrogen loads for the Susquehanna River.

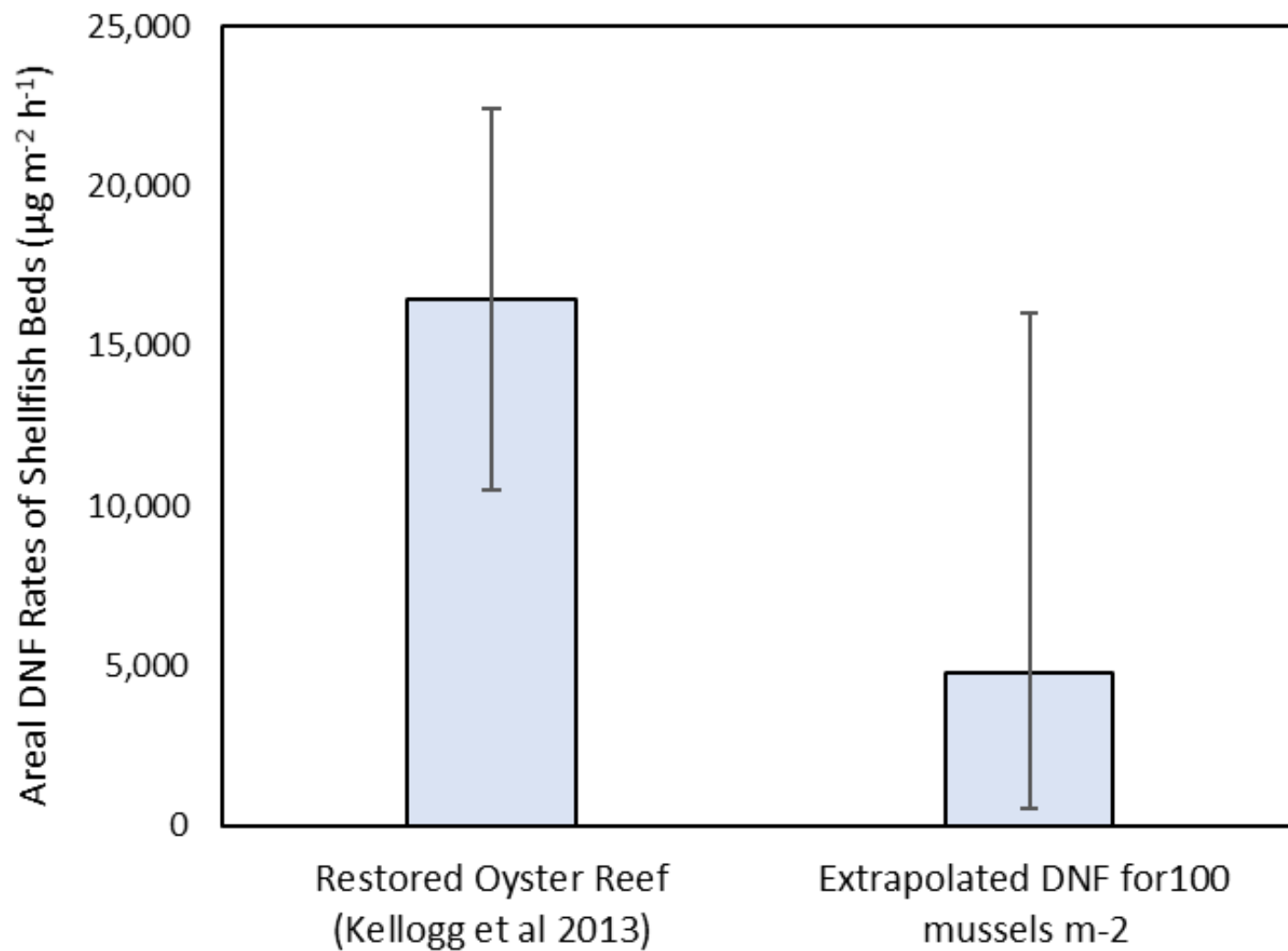


Estimate Description	Mussel Density	Units	Range of denitrification		
			Low 4.8 µg N g ⁻¹ h ⁻¹	Average 38.0 µg N g ⁻¹ h ⁻¹	High 84.1 µg N g ⁻¹ h ⁻¹
DNFm per unit area of streambed at assumed mussel density		µg N m ⁻² h ⁻¹	5.0	39.9	231.7
Estimated annual DNFm in river network	1 ind m ⁻²	lbs N y ⁻¹	39,615	313,621	1,821,300
Estimated DNFm as % of total nitrogen load (1 ind m ²)		%	0.03%	0.2%	1.3%
DNFm per unit area of streambed at assumed mussel density		µg N m ⁻² h ⁻¹	50	399	2317
Estimated annual DNFm in river network	10 ind m ⁻²	lbs N y ⁻¹	396,153	3,136,210	18,212,996
Estimated DNFm as % of total nitrogen load		%	0.3%	2.2%	12.7%



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Several recent peer review studies suggest
Mussels Enhance Denitrification



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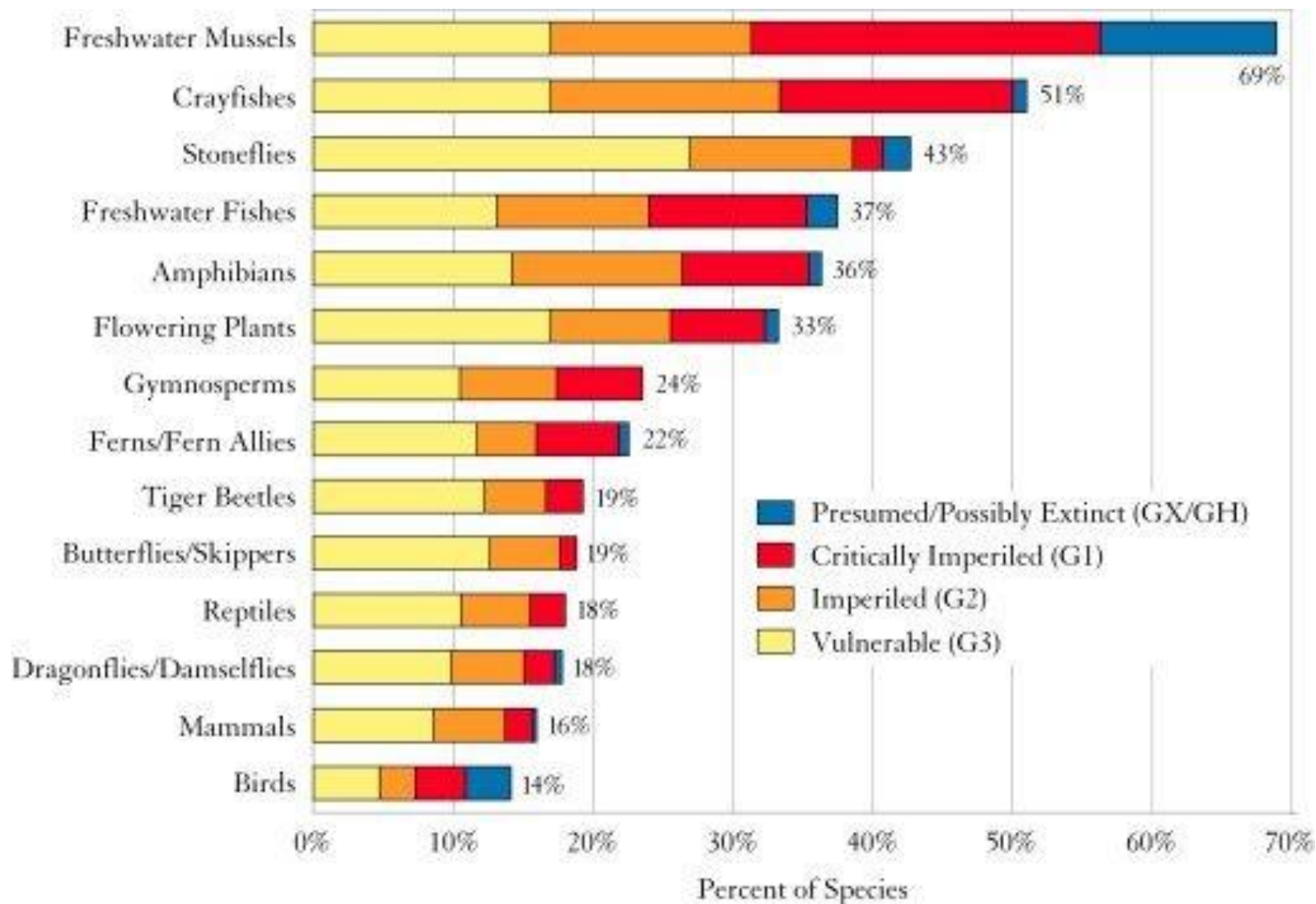
Mussel hot spots are likely within orders of magnitude of oyster reefs, but probably lower due to density

4. Freshwater Mussels are more threatened/endangered than any other class of organisms in the country.



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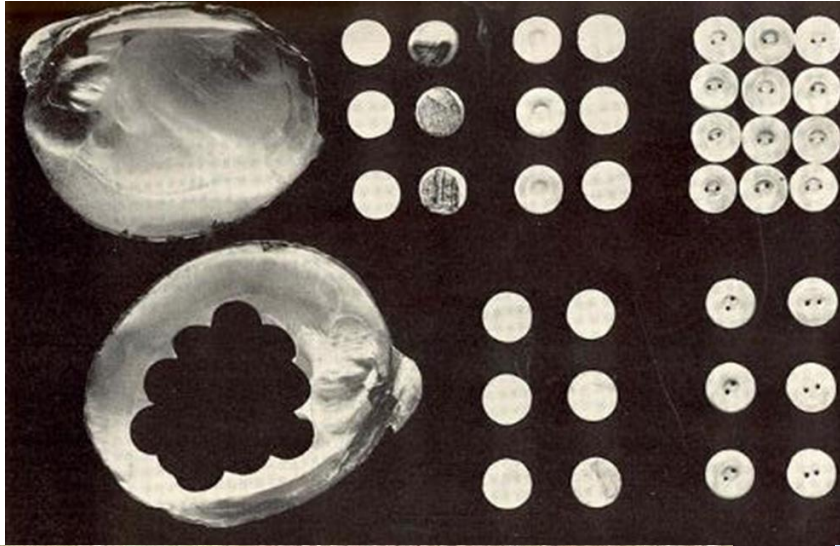
The MOST CRITICALLY IMPERILED group of organisms

3. Mussels are in serious trouble, in part due to issues that also plague Chesapeake Bay health.



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Why are mussels struggling?

2. Mussel propagation has made tremendous strides in the past 10-20 years.



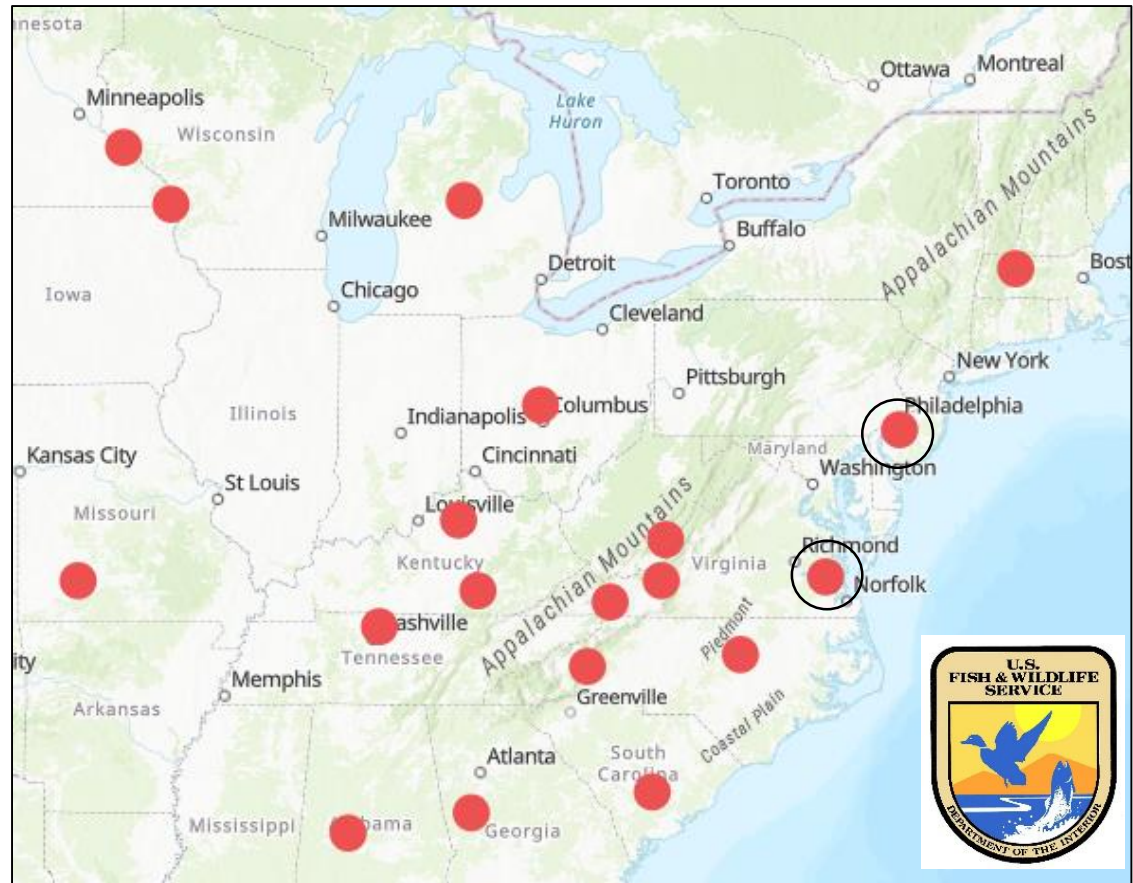
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Current Propagation Facilities

Funding Agency

- 6 State Agency
- 4 University
- 11 Federal Hatcheries
- 1 Zoo
- 1 NGO
- Facility opening in Philadelphia to serve Delaware and Susquehanna



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The Philadelphia Inquirer

Half a million mussels to be hatched yearly at Bartram's Garden

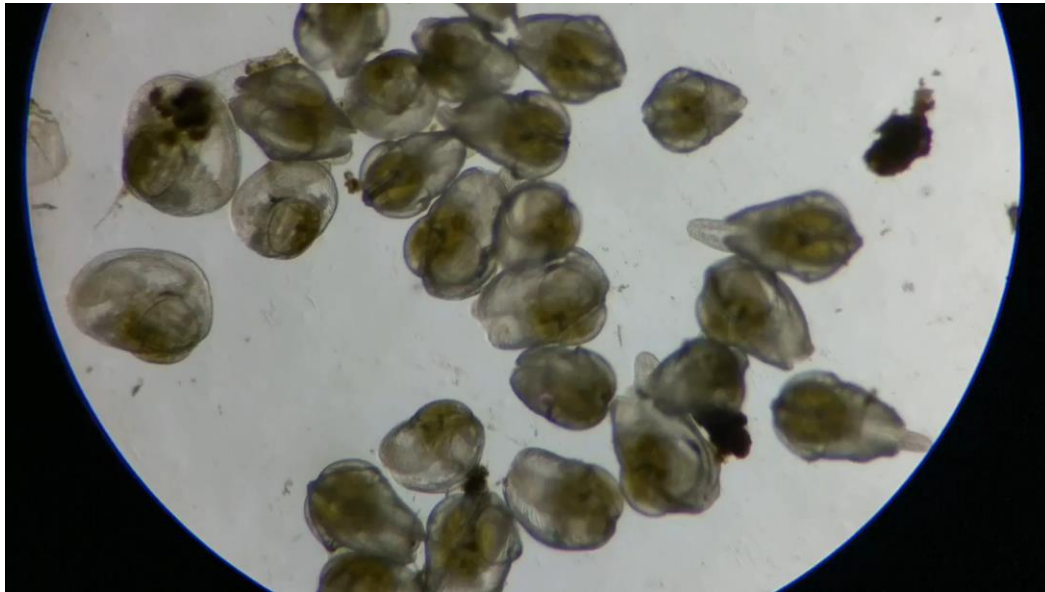
by Frank Kummer, Updated: January 15, 2019



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New Philadelphia facility to serve
Susquehanna and Delaware Basins!

Hatchery propagation research is making serious strides; utilizes fish host relationship.



Restoration of some species involves a technique using rabbit serum.



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1. Mussels are captivating!



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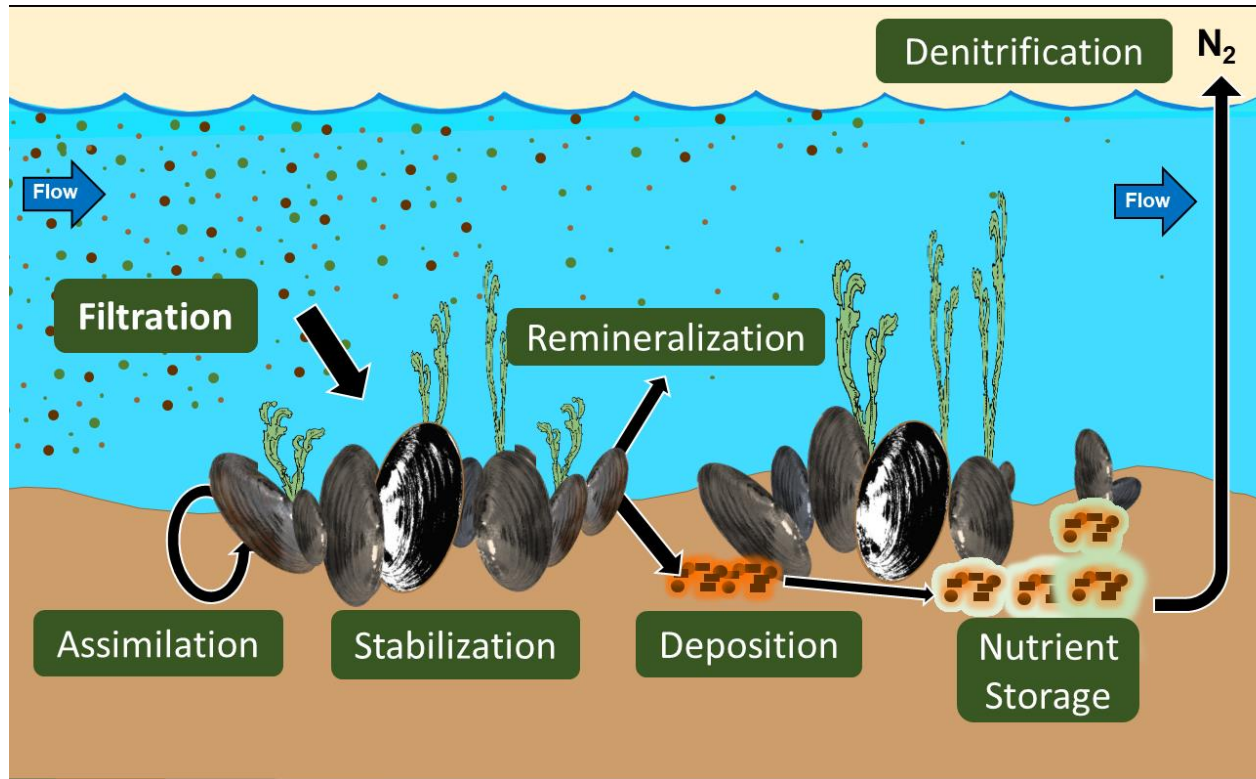
- **Research Findings:/Recommendation # 1**
- Significant efforts have been made to document mussel populations across the region yet no aggregated database exists which includes this information.
- **Recommendation:** Compile and analyze existing mussel distribution datasets and aggregate into a sharable form
 - Assessing trends in mussel abundance and diversity.
 - Identifying “hotspots” where mussel protection is most needed.
 - Determining effects of mussel restoration efforts, and whether best management practices are yielding healthy mussel populations.
 - Improving records for considerations in the context of damages.



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We need to keep records as a
partnership on this subject

- **Research Finding 2:** Mussels enhance denitrification!
The partnership should support research efforts and pursue BMP Expert panel on this subject.



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N Removal effects are but
significant knowledge gaps
remain

Programmatic Recommendation 1. We encourage the partnership to incorporate mussel considerations across various workgroups and GITs. Specifically:

- Address mussel considerations in the next Fish Habitat management strategies 2-year Work plan
- Incorporate mussel factors into relevant management strategies under the Vital Habitats Goal in the 2014 Chesapeake Bay Watershed Agreement, such as Stream Health, Fish Passage, and SAV.

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diverse citizen and stakeholder presence that will build upon and sustain measurable natural resource improvements. NFWF is soliciting proposals that provide measurable contributions for the following selected goals and outcomes of the Chesapeake Bay Watershed Agreement and associated with NFWF's [Chesapeake Bay Business Plan](#) and will place priority emphasis on projects that meaningfully and materially contribute to multiple priority outcomes:

Focus	Outcome	Activity	Geographic Focus
	Reduce nitrogen, phosphorus, and	<ul style="list-style-type: none"> - Improve water quality in agricultural areas by implementing best management practices to reduce polluted runoff - Improve water quality in urban and suburban areas by implementing green stormwater infrastructure practices to 	
River Herring	Restore access and use of high-quality migratory river and stream habitat	<ul style="list-style-type: none"> - Implement high priority, cost-effective connectivity enhancement projects through culvert replacement, fish passage improvements, and dam removal 	Priority Culverts for River Herring
Eastern Oyster	Restore oyster populations in priority Chesapeake Bay tributaries	<ul style="list-style-type: none"> - Restore native oyster reefs in targeted tributaries through spat production and reef construction 	Oyster Restoration Tributaries
Capacity and Planning	Motivate individuals in the watershed to adopt behaviors that benefit water quality, species, and habitats	<ul style="list-style-type: none"> - Enlist individuals in local volunteer events to restore local natural resources and providing hands-on education and skill-building for individual action - Develop or improve conservation, watershed, or habitat management plans that provide guidance to landowners, organizations, or local governments on how to manage properties and communities for improved conservation outcomes 	N/A

Mussels currently absent from NFWF Priority Species (Brook Trout, Black Duck, Herring, Oysters, etc.)

2. Tell the story of Mussels to improve engagement Bay issues in upper portions of the watershed

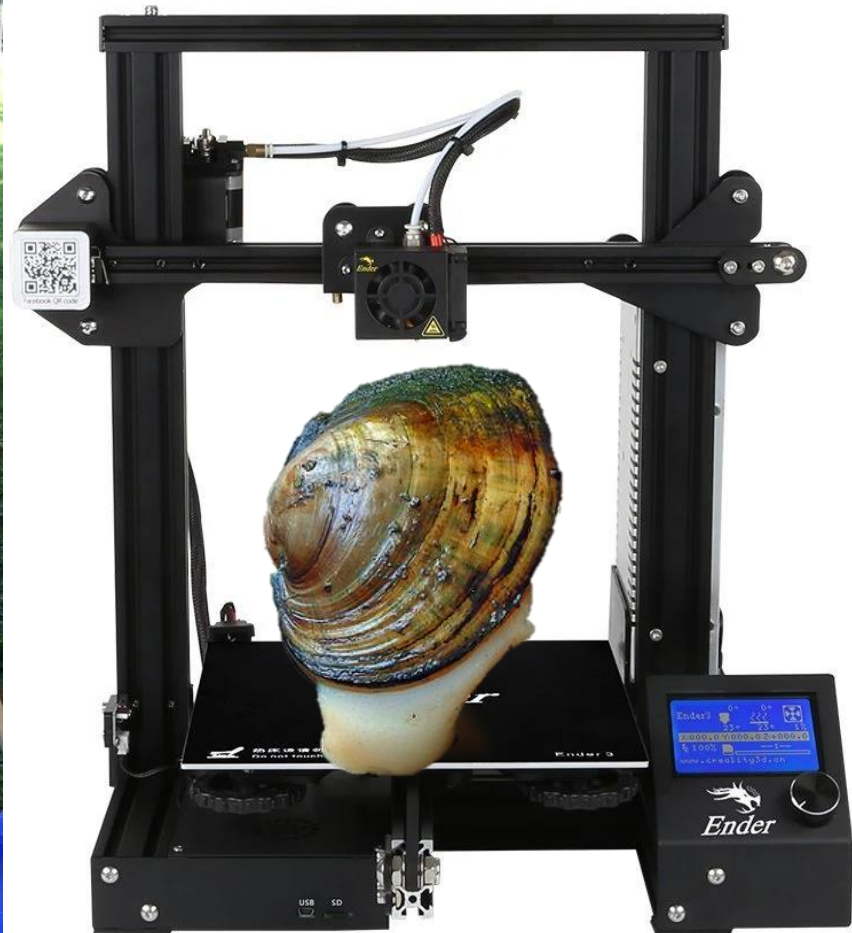
- *The communications workgroup should feature stories on Freshwater Mussels to engage local stakeholders in non-tidal regions of the Watershed*
- *The Citizen Stewardship Goal Implementation Team and the Chesapeake Monitoring Cooperative should work with freshwater mussel conservation experts to incorporate freshwater mussels into citizen science efforts*
- *The Chesapeake Bay modeling workgroup should include freshwater mussels as part of the co-benefit framework and include these benefits within CAST.*



•3. Consider overlap between nutrient mitigation and freshwater mussel restoration

- Explore collaborative opportunities to achieve nitrogen reductions and address new ammonia criteria through the wastewater workgroup .
- The Partnership should consider mussel impacts and benefits related to restoration efforts and should specifically consider mussel protection and restoration in the context of stream restoration.





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Develop 3-d shell database to share

- Webinar focused on freshwater mussels with a Bay Lens:

DISCOVERING THE SECRETS OF FRESHWATER MUSSELS

- <https://www.cbf.org/events/webinars/webinar-discovering-the-secrets-of-freshwater-mussels.html>



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Questions