



Harrison Lake National Fish Hatchery

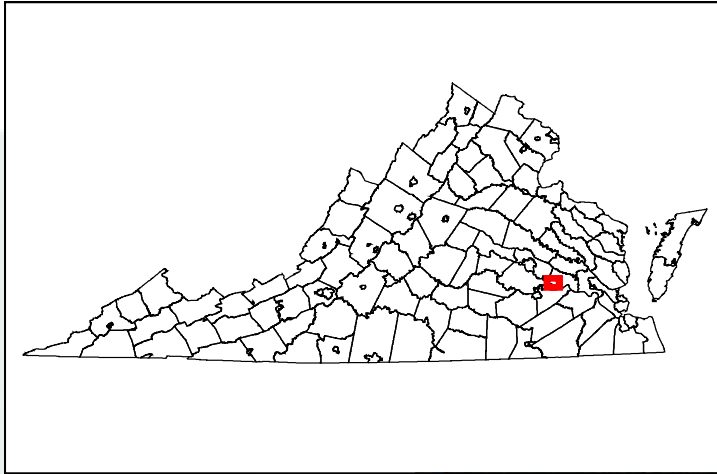
Rachel Mair, United States Fish and Wildlife Service, Charles City, Virginia

Rachel_Mair@fws.gov





Harrison Lake National Fish Hatchery

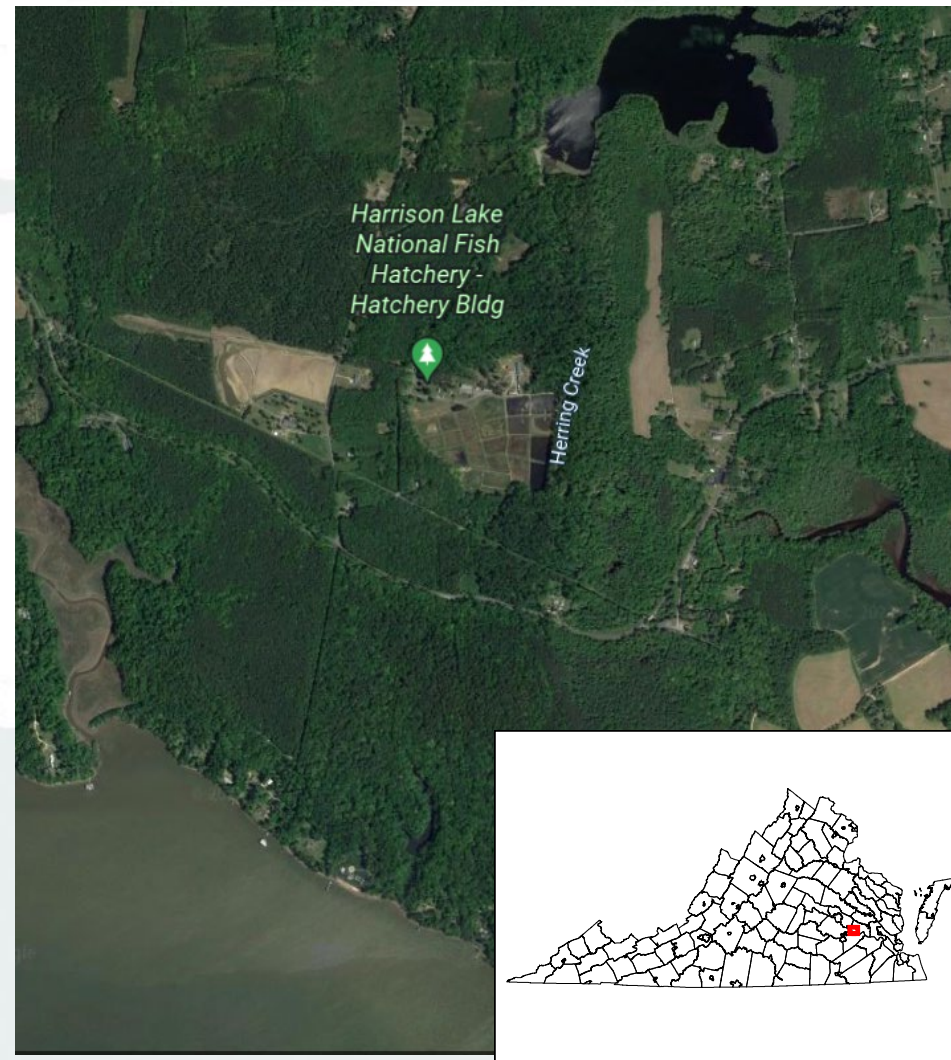




Harrison Lake National Fish Hatchery

Overview

- 22 miles SE Richmond, VA
- 444-acre facility
- 90-acre Harrison Lake
- Many recreation opportunities
 - Hiking trail, boating, fishing, birdwatching, bicycling, wildlife observation
- VFWCO and Eastern Rivers NWR





Harrison Lake National Fish Hatchery

Fish Propagation

- Established 1930
- Produced Catfish, Striped Bass, American Shad
- Produce River Herring, American Shad?
- Herring project with VCU Rice Rivers
- Tribal intern training





Extinction Rates of North American Freshwater Fauna

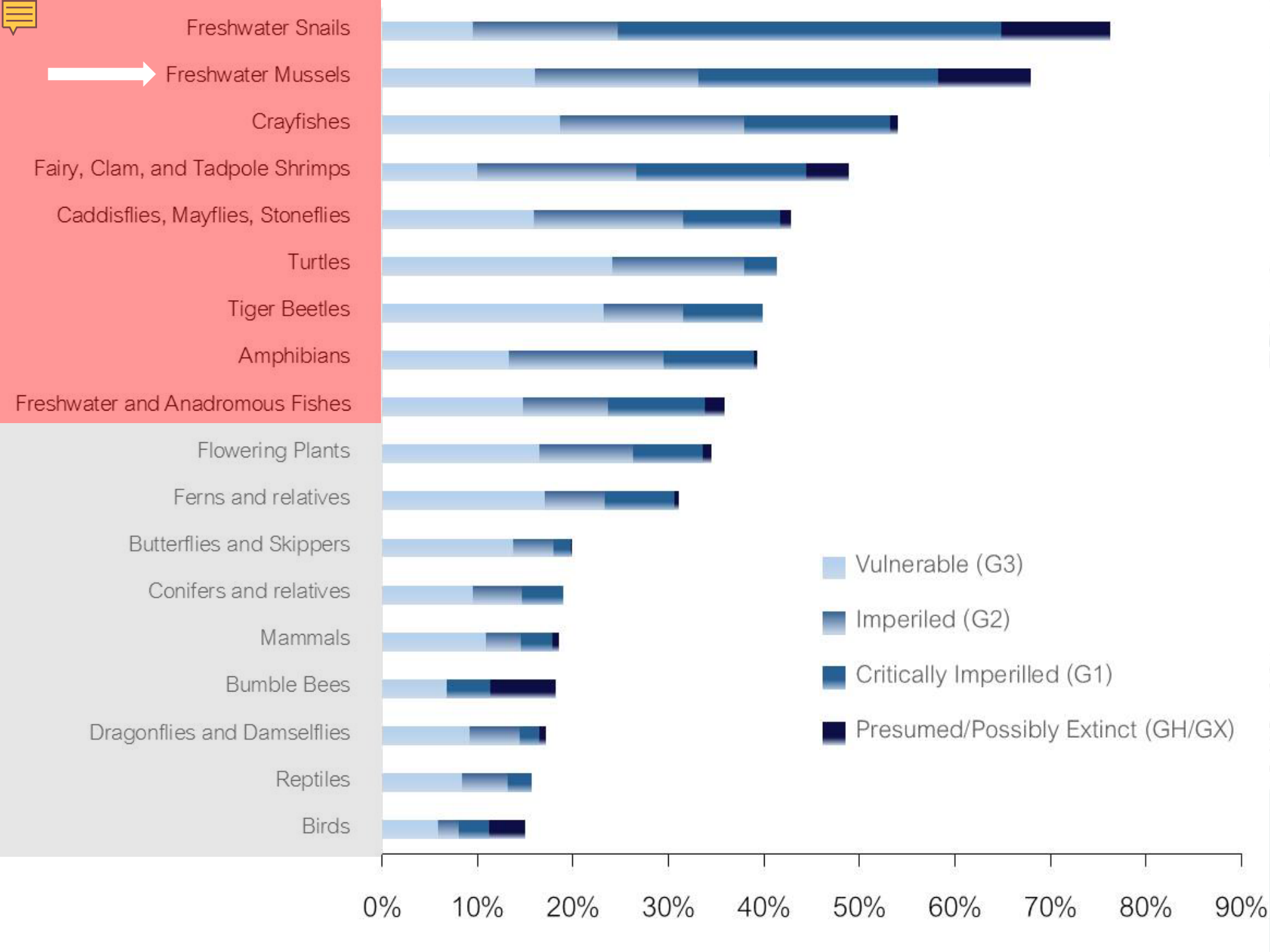
ANTHONY RICCIARDI* AND JOSEPH B. RASMUSSEN†

*Department of Biology, Dalhousie University, Halifax (NS), B3H 4J1, Canada,
email ricciard@is.dal.ca

†Department of Biology, McGill University, Montreal (QC) H3A 1B1, Canada

Abstract: *Since 1900, 123 freshwater animal species have been recorded as extinct in North America. Hundreds of additional species of fishes, mollusks, crayfishes, and amphibians are considered imperiled. Using an exponential decay model, we derived recent and future extinction rates for North American freshwater fauna that are five times higher than those for terrestrial fauna. Assuming that imperiled freshwater species will not survive throughout the next century, our model projects a future extinction rate of 4% per decade, which suggests that North America's temperate freshwater ecosystems are being depleted of species as rapidly as tropical forests.*

“...freshwater extinction rates 5X higher than in terrestrial systems and rival extinction rates for tropical rainforests.”





Causes



- Habitat modification
- Pollution
- Loss of fish hosts
- Sedimentation
- Invasive species





Causes



Recruitment failure

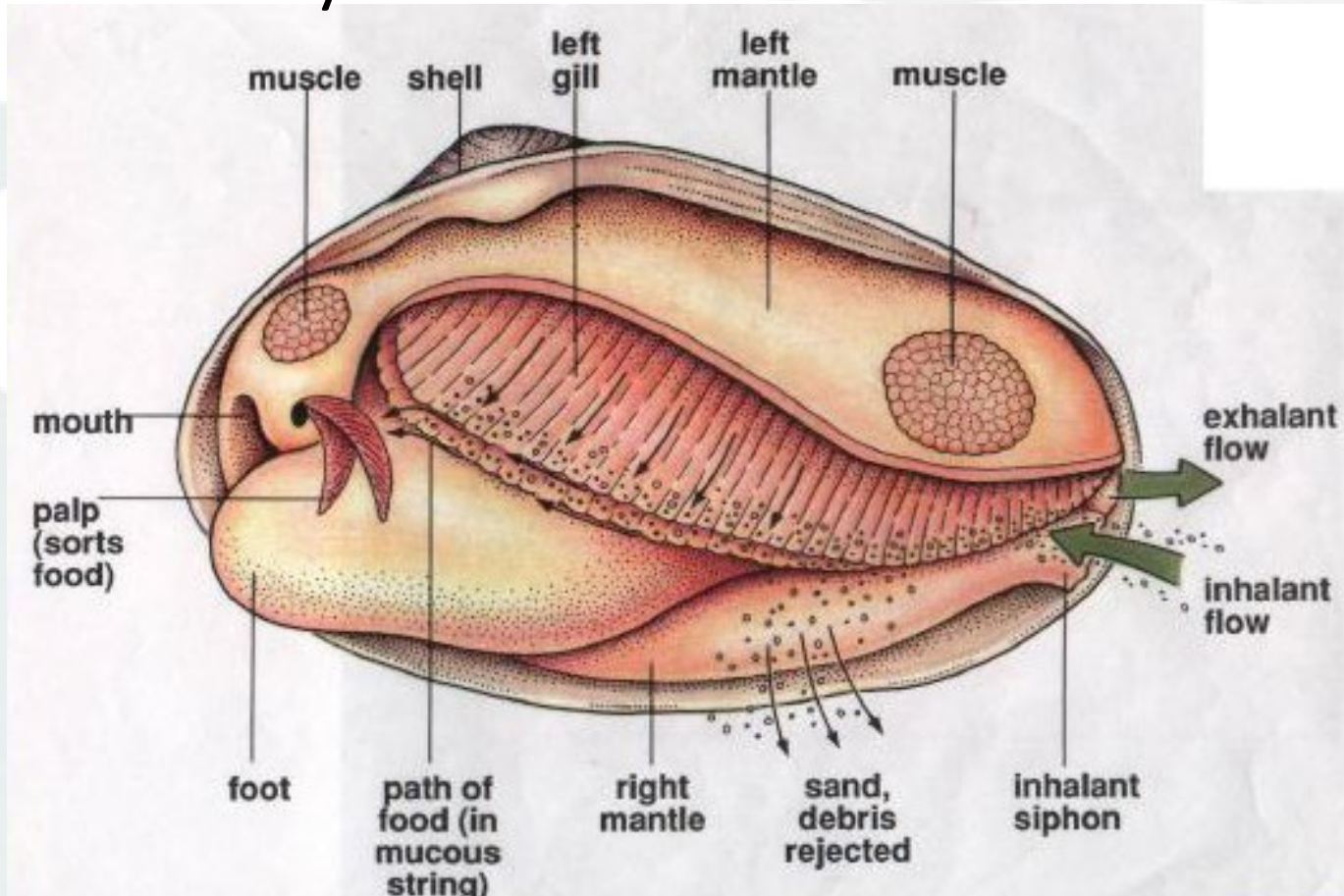
Strayer and Malcom 2012

- No relationship to fine sediment, interstitial DO, fish host abundance, or crayfish predator abundance.
- Correlated to unionized ammonia greater than 0.2 mg N/L



Why are they important?

They are nature's water filter



Nature's Water Filter

Time 0

No mussels

8 adult mussels in 10 gallon tank



Time: 8 Hours





16 hours later

No mussels

8 adult mussels



Clean Water

A bed of 200,000 freshwater mussels filters

1.5 million gallons of water per day.

No chemicals

No electricity

Free of Charge!

No scrubbers

No fancy filters



U.S. Fish & Wildlife Service

North Atlantic – Appalachian Region

Conserving the Nature of America



An underwater photograph showing a dense colony of freshwater mussels on a rocky riverbed. The mussels are dark, rounded, and clustered together, covering a significant portion of the visible substrate. The water is clear, and the lighting is natural, highlighting the textures of the shells and the surrounding rocks and sediment.

Why Do We Care?

Ecosystem Services and Ecosystem Function

Photo courtesy of Jayne Brim-Box,
CTUIR Freshwater Mussel Project



Mussels provide valuable services

- Ecosystem
 - Filter water: 2-4 L hr⁻¹
 - Bind sediment: 11 lbs/yr
 - Aerate sediments
 - Prevent compaction
 - Filter toxins
 - Indicators of health
 - Biodiversity
- Commercial value
- Cultural-historical value
- Human health





Ecological Effects



Roger Tabor, USFWS

Healthy freshwater mussel beds

- 50-90% of the benthic biomass
- can exceed all other benthic species by an order of magnitude



Ecological Effects



Roger Tabor, USFWS

Healthy freshwater mussel beds

- filter water volumes equal to or greater than daily stream discharge
- transfer food from water column to benthos
- higher macroinvertebrate abundances



Ecological Effects



Roger Tabor, USFWS

Healthy freshwater mussel beds

- Stabilize substrate
- Increase oxygen penetration into sediments



Recovery Efforts

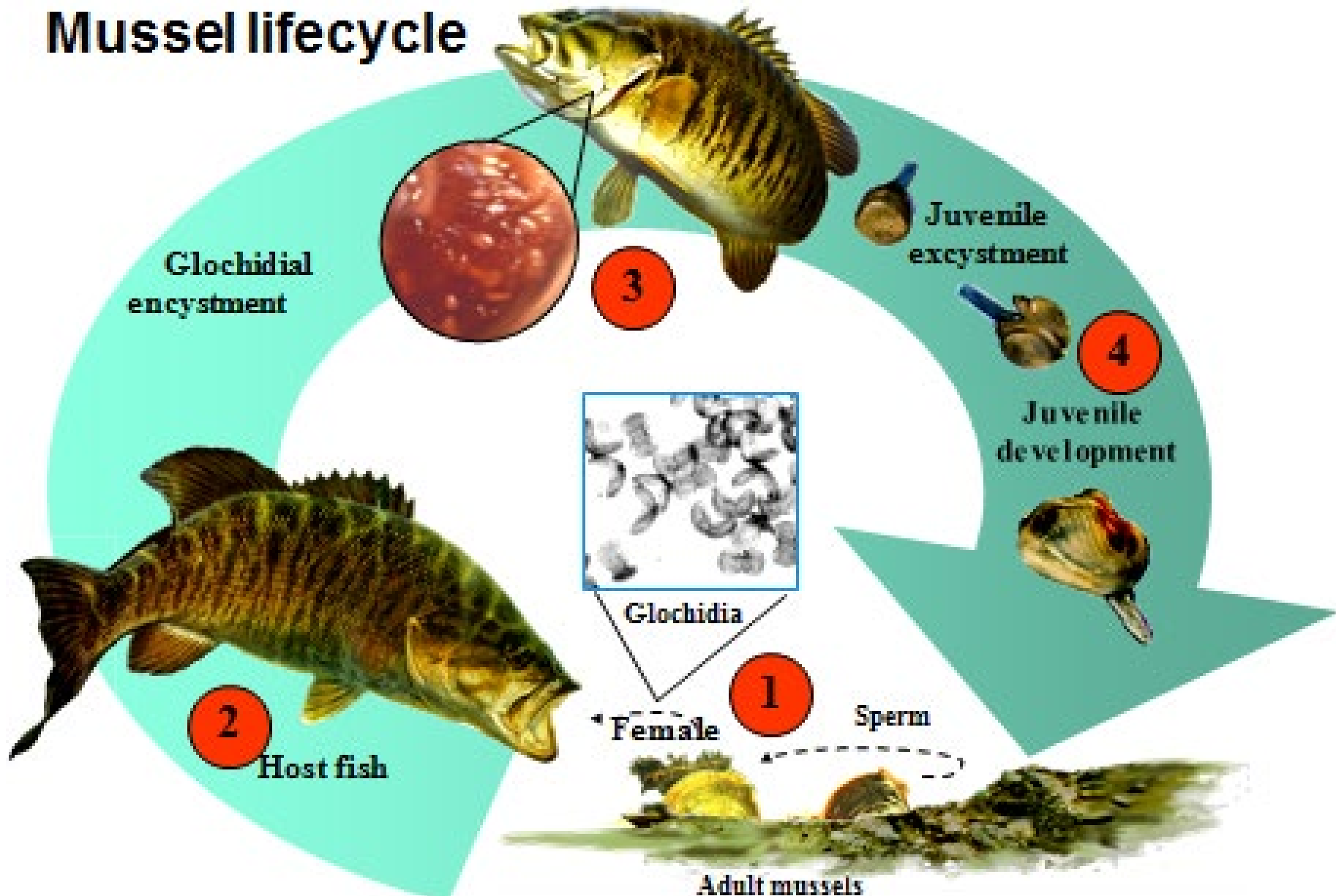


Scott Comings, TNC

- Habitat Protection
- Habitat Restoration
- EPA Water Quality Criteria
- Relocation
- Propagation



Mussel lifecycle





Mimicry

One animal looking like another



Monarch

Viceroy

Sinaloan Milk Snake



Coral Snake



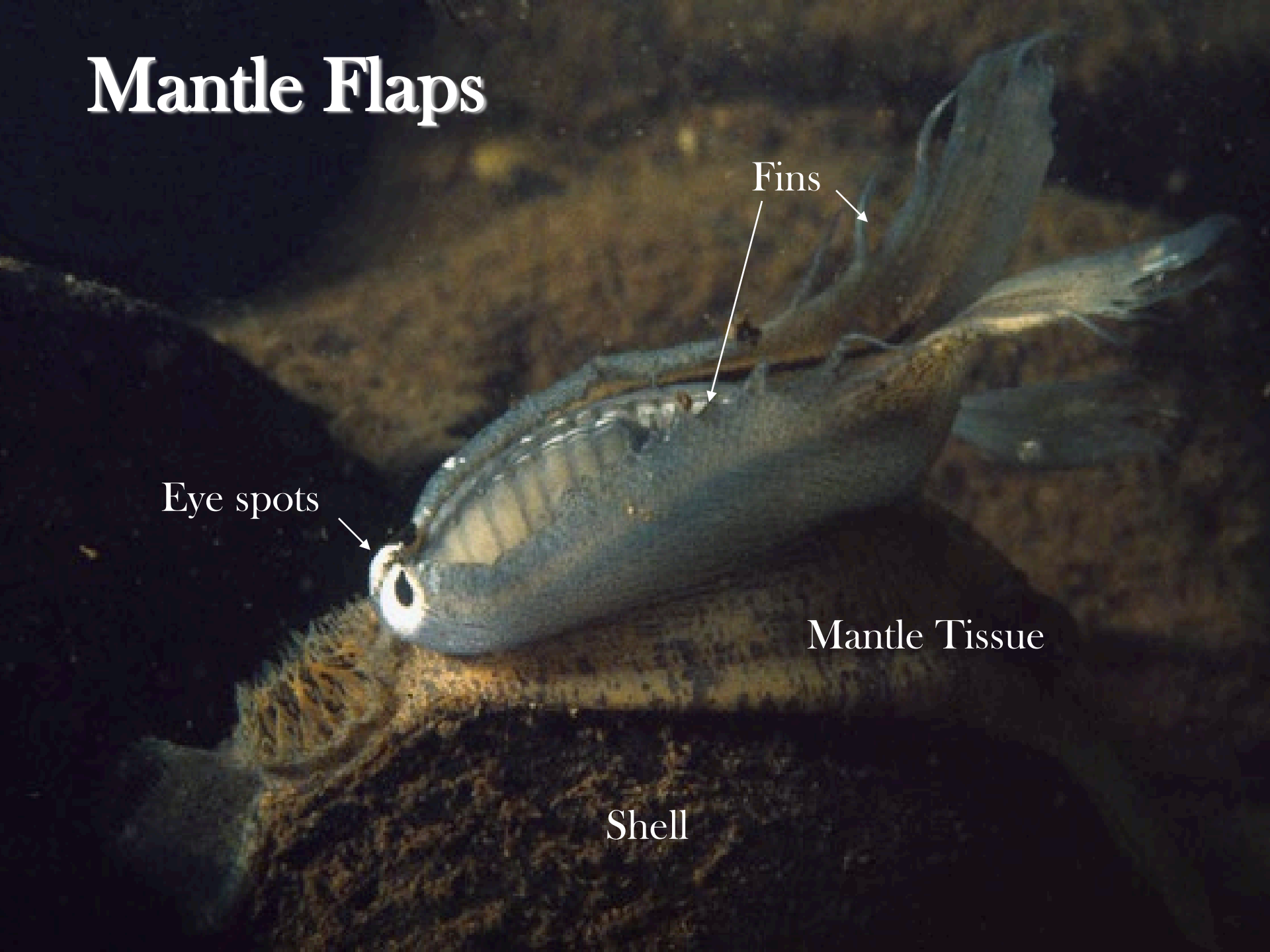
Mantle Flaps

Eye spots

Fins

Mantle Tissue

Shell





U.S. Fish & Wildlife Service

North Atlantic – Appalachian Region

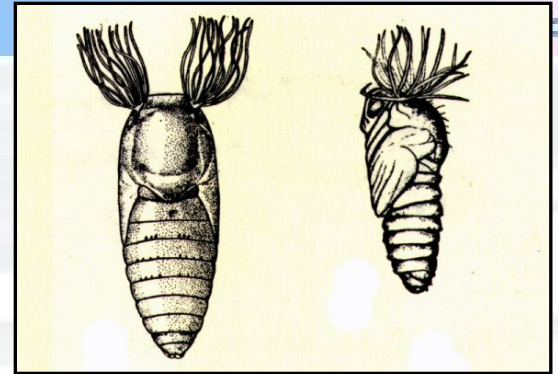
Conserving the Nature of America





Conglutinates

- package of young mussels



Black fly





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From the *Unio* Gallery



Host capture by snuffbox mussel

Epioblasma triquetra

M. C. Barnhart 2005



U.S. Fish & Wildlife Service

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Conserving the Nature of America





Freshwater Mussel Program

Virginia Fisheries and Aquatic Wildlife Center

Collaborative facility

- - USFWS and DWR
- - Started 2007/2008
- - Propagation
- - Surveys
- - Applied Research





Starting a propagation program

Why are we raising these mussels?

- Define clear goals and objectives
- Create a Propagation Plan
- Assemble an advisory board to review your plan
- Involve states, ES, etc
- Policy Regarding Controlled Propagation of Species Listed Under the Endangered Species Act

Freshwater Mussel Habitat Restoration, Propagation, Augmentation, and Reintroduction Plan for the White Sulphur Springs National Fish Hatchery

**Julie Devers¹, Matthew Patterson², Rachel Mair² and
Catherine Gatenby²**

¹Maryland Fisheries Resource Office, U.S. Fish and Wildlife Service
177 Admiral Cochrane Drive Annapolis, MD 21401

²White Sulphur Springs National Fish Hatchery, U.S. Fish and Wildlife Service
400 E. Main St. White Sulphur Springs, WV 24986

August, 2007



Is propagation the best option?

Propagation Policy states....

Priority number one is to recover wild populations in their natural habitat and propagation should be considered a last resort.





Virginia Fisheries and Aquatic Wildlife Center



Overview

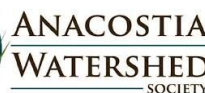
- Produced over 10 million juveniles of 14 species
- Released 245,000 tagged of 9 species
- Supplied 300,000 to 13 states and federal researchers across the country
- Conduct applied research
- Complete surveys and monitoring





Mussel Restoration Projects

- Upper Mattaponi Tribal Wildlife Grant
- Anacostia Watershed Restoration
- Partnership for Delaware Estuary
- James River Restoration
- Reston Restoration Project
- Dan River Restoration
- NFWF invitro propagation technology
- South River NRDAR
- USFS James Spiny mussel Recovery Project
- SWG Brook Floater Restoration
- VDOT Green Floater Restoration
- Dominion Power
- 2 FWS funded systemwide projects





Mussel releases in Virginia

Nottoway River

North Fork Roanoke River

Pigg River

Rappahannock River

Pamunkey River

Blackwater River

Meherrin River

Appomattox River

Johns Creek

Mattaponi River

Jenny Creek

Tye River

South River

Cowpasture River

Rock Island Creek

James River

South Fork Shenandoah River

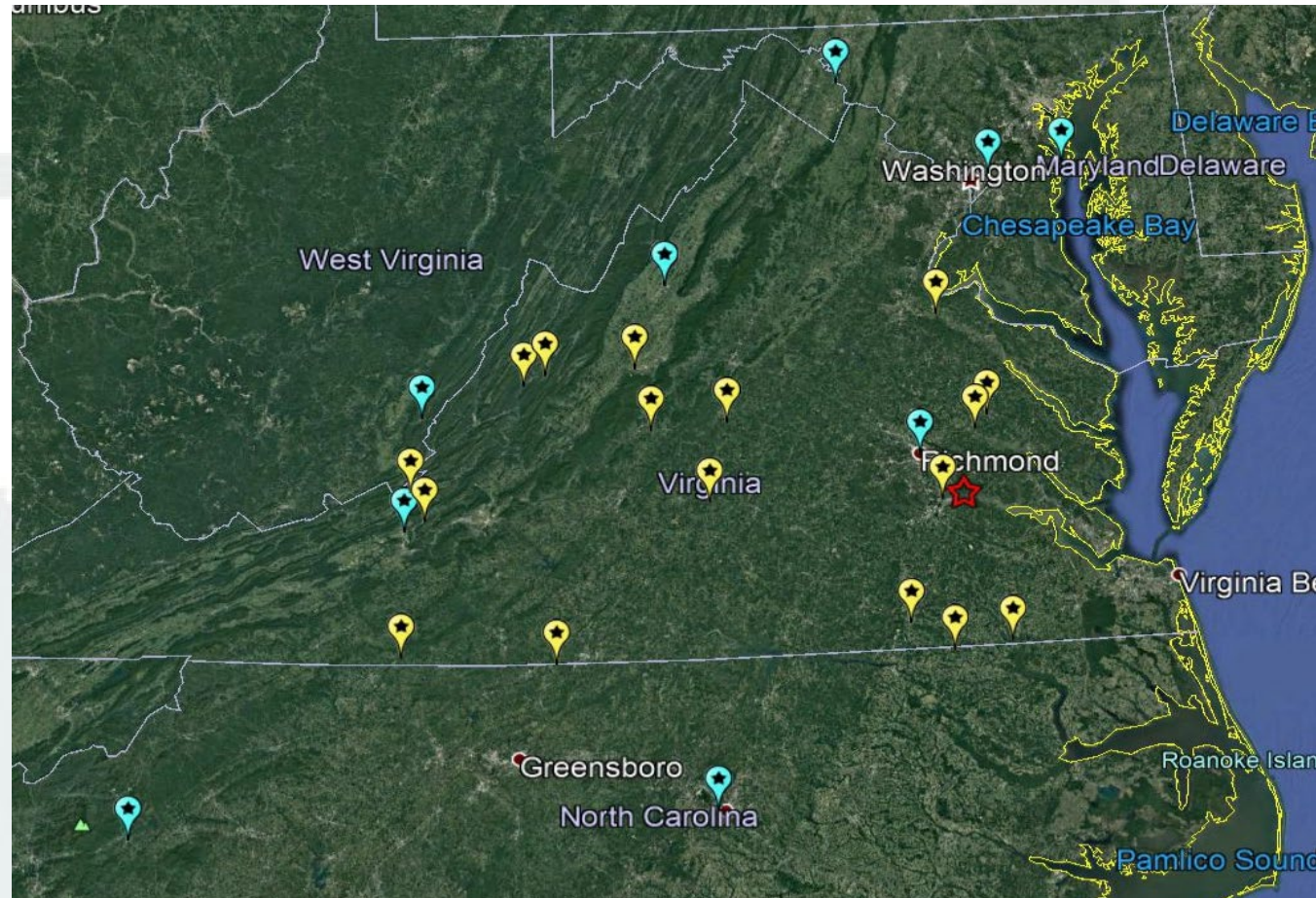
Goose Creek

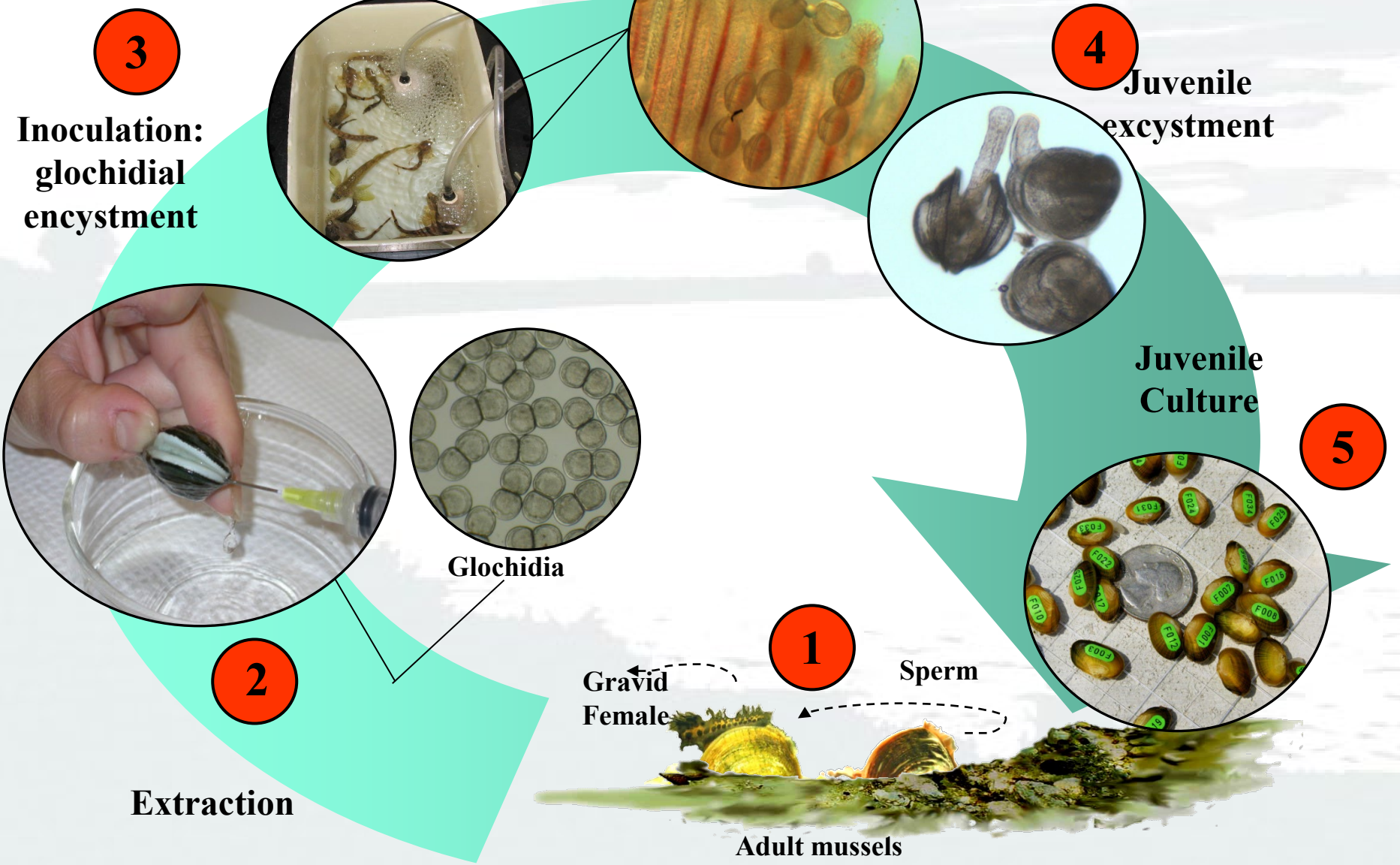




VFAWC Mussel Stocking and Distribution

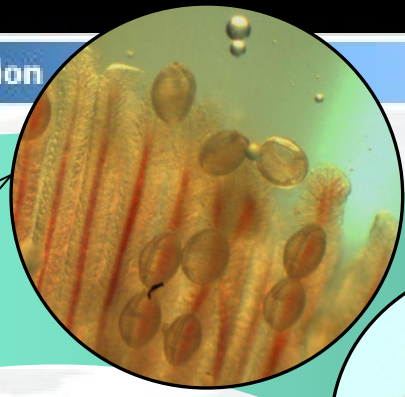
- Distributed mussels to 13 states for research, methods testing, toxicology studies
- Mussels stocked in 18 Rivers





3

**Inoculation:
glochidial
encystment**



4

**Juvenile
excystment**



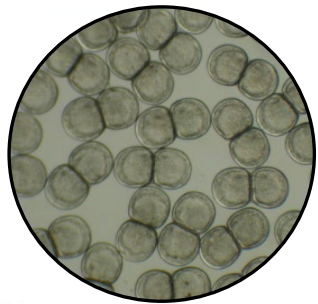
**Juvenile
Culture**

5



2

Extraction

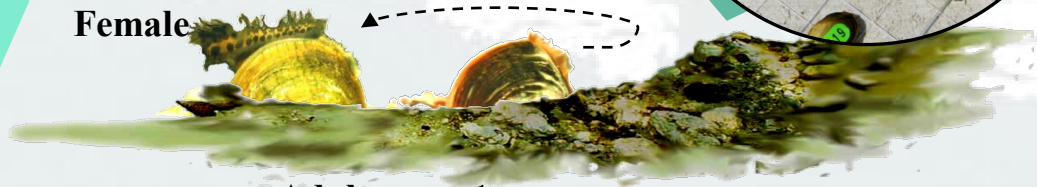


Glochidia

1

**Gravid
Female**

Sperm



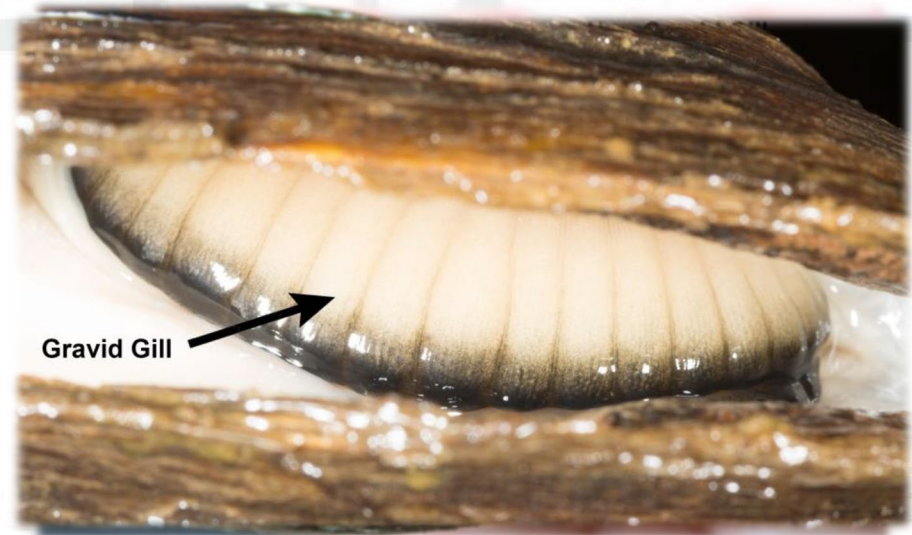
Adult mussels

Mussel Production



Broodstock collection

- Long term brooders
- Short term brooders
- Mussel Collection
 - Sterilize gear before
 - Transport in aerated coolers with or without substrate
 - Have temperature maintained
 - Check for gravidity



Photos: Ryan Hagerty, USFWS



Obtaining larvae

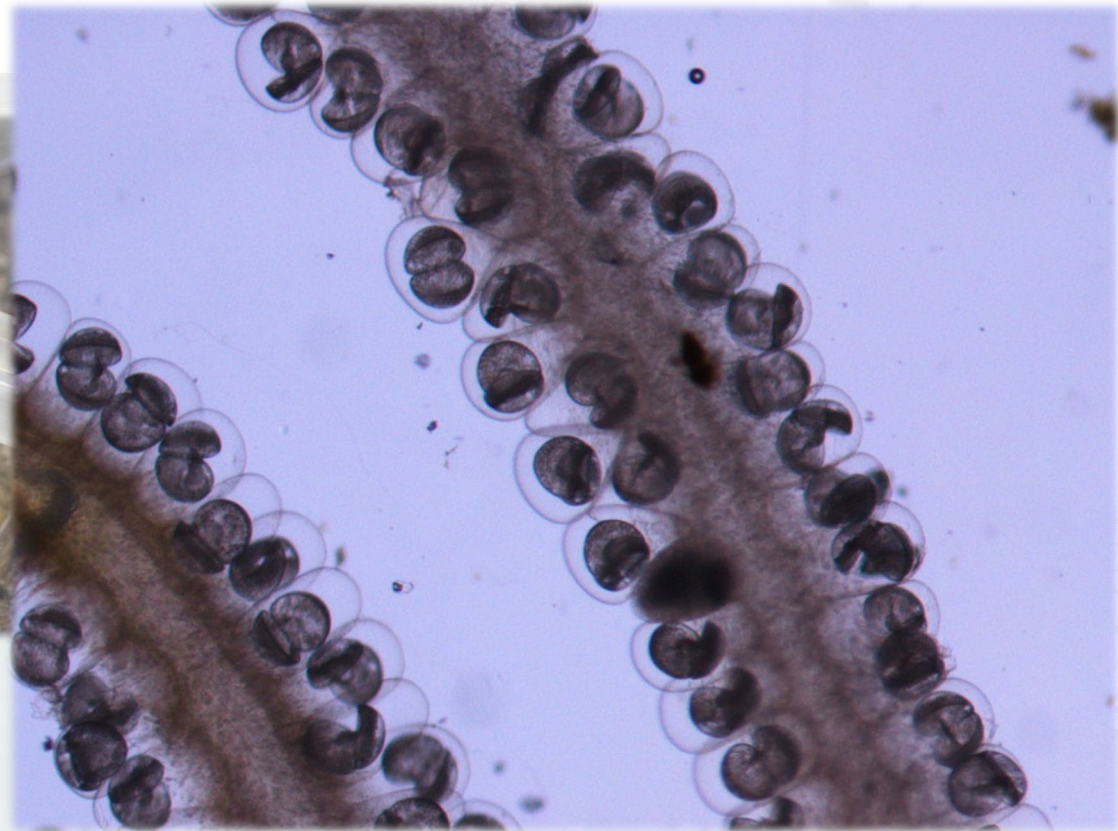


Photo: Ryan Hagerty, USFWS



Infesting fish

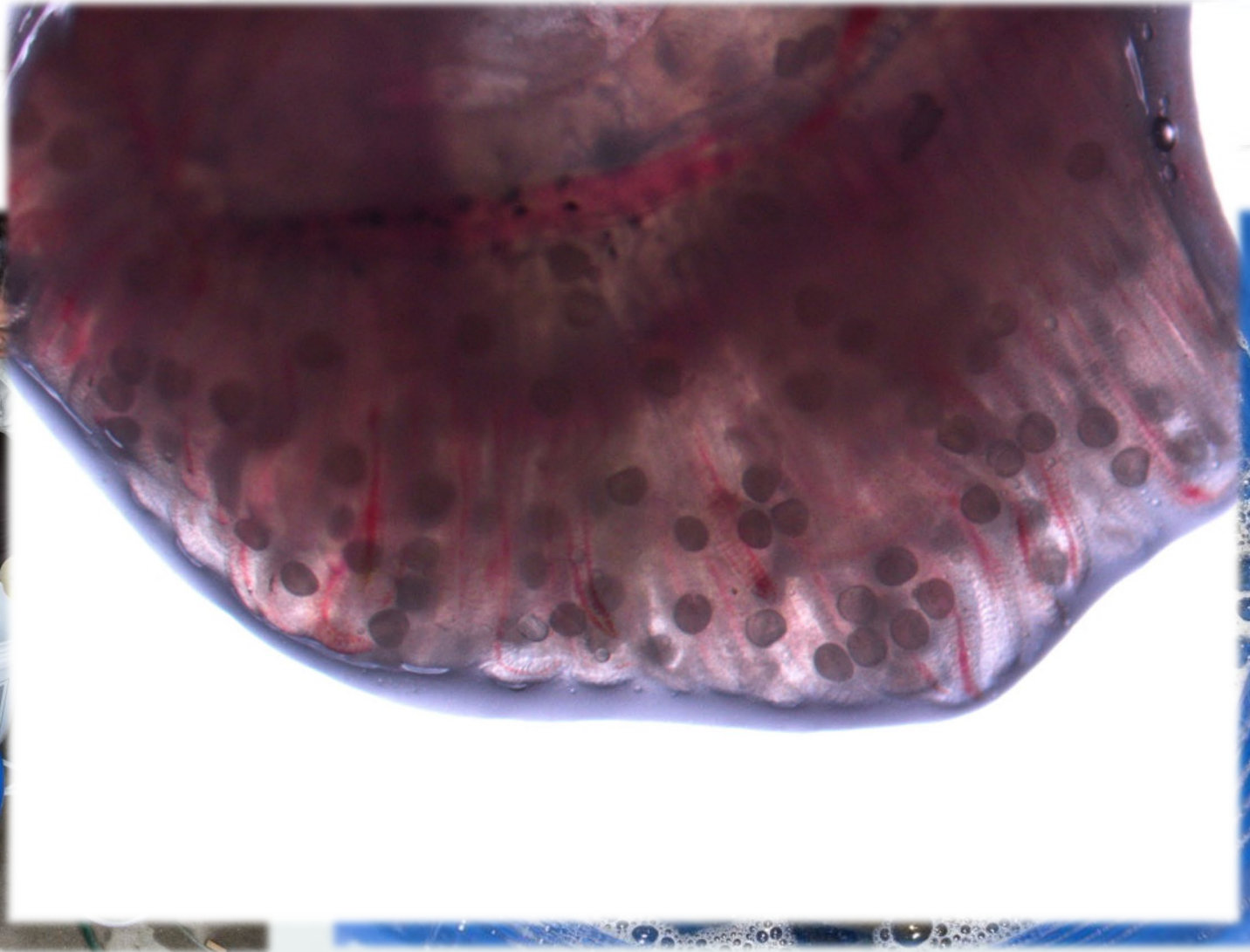
- Extraction or larvae release
 - Syringe method
 - Warming
 - Isolation and natural release
 - Suction
- Aerate container add larvae, fish



Container	Species	Host Number	Water Level	Inoculation Length
3L AHAB Tank	darters, sculpin	10 – 20	1"	45-60 min
10L AHAB Tank	darters, sculpin	50 – 100	1"	45-60 min
5ga Bucket	bass, sunfish	5 - 15	1 ga	10 – 30 min
17ga Rope Handle Tub	Any species	50 - 200	9 ga	Species Dependant



Infestation



Photos: Ryan Hagerty, USFWS



Collection of Juveniles

- Place fish in aquaria
- Excyst 2-4 wks at 20°C
- Collect in sieves
- Siphon tanks
- Count and record
- Place in culture systems





Juvenile culture

- Range of techniques, options and involvement
 - Streamside
 - Free release
 - Cages
 - Laboratory culture
 - Grow out only





Indoor culture systems

- Every facility has different variables
 - Mussel species
 - Water quality
 - Food
 - Flow
 - Personnel
 - System maintenance...etc





Initial culture of day-old juveniles

Juveniles are vulnerable to:

- Predation
- Handling stress
- Escapement
- Overfeeding
- Water quality
- Poor nutrition





Rearing pans

- 5 quart pans, 1 inch gasket, male adapter and pvc
- Substrate of 200 mL of fine white play sand (<1 mm)
- Flow-through or recirculating
- Flow 1-1.5 L min⁻¹



Photo credit both photos: Nathan Eckert, USFWS.



Advantages of Indoor Culture

Keep species separate

Keep river drainages separate

Helps prevent the spread of organisms from one system to another

Can readily monitor health/survival of mussels

Can control culture environment (predators, temperature, amount and type of food, etc.)

Lower risk of a pollution event

Advantages of Outdoor Culture

Don't need to rely on algae as only food source

Don't need to purchase commercially available food or grow your own

Mussels need more than algae to grow and survive well. Outdoor environments have numerous species of algae, zooplankton and bacteria. Observed growth rates are often significantly higher in outdoor cultures.

Much less labor intensive

Less operational costs

Smaller footprint indoors



Baskets

- Developed at HLNFH
- Excellent growth and survival
- Low maintenance
- Low effort and manpower
- Low cost



Photo Brian Watson, Virginia Department of Game and Inland Fisheries.



Baskets

- Juveniles of any age, 3-10 mm
- Deployed when water temps begin to warm
- Juveniles are removed within 3-14 months





Tagging

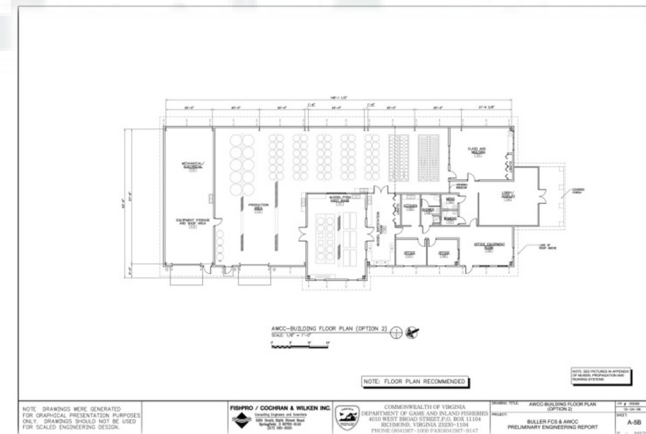
- Black superglue
- Glue on shellfish tags
- Laser engraving
- Pit tags
- Glitter glue





Setting up a mussel facility

- Is there a facility in place already?
- Available infrastructure
- Retrofitting old facility
- Hatchery design
 - Space- 2100 sq ft
 - Biosecurity
 - Brood stock holding
 - Host fish/mussel requirements (temperature, water quality parameters, etc.)
 - Drains, where water is drained





Setting up mussel facility

- Equipment required
 - Chillers/heaters
 - Pumps
 - Electricity
 - Tanks
 - Lab supplies
 - Microscopes
- Experienced staff to run program over long-term
 - 3 staff during season
- Staff interactions





VFAWC ponds



Photo: Ben Davis, USFWS

Questions?

Rachel Mair
Harrison Lake National Fish Hatchery, USFWS
Rachel_Mair@fws.gov