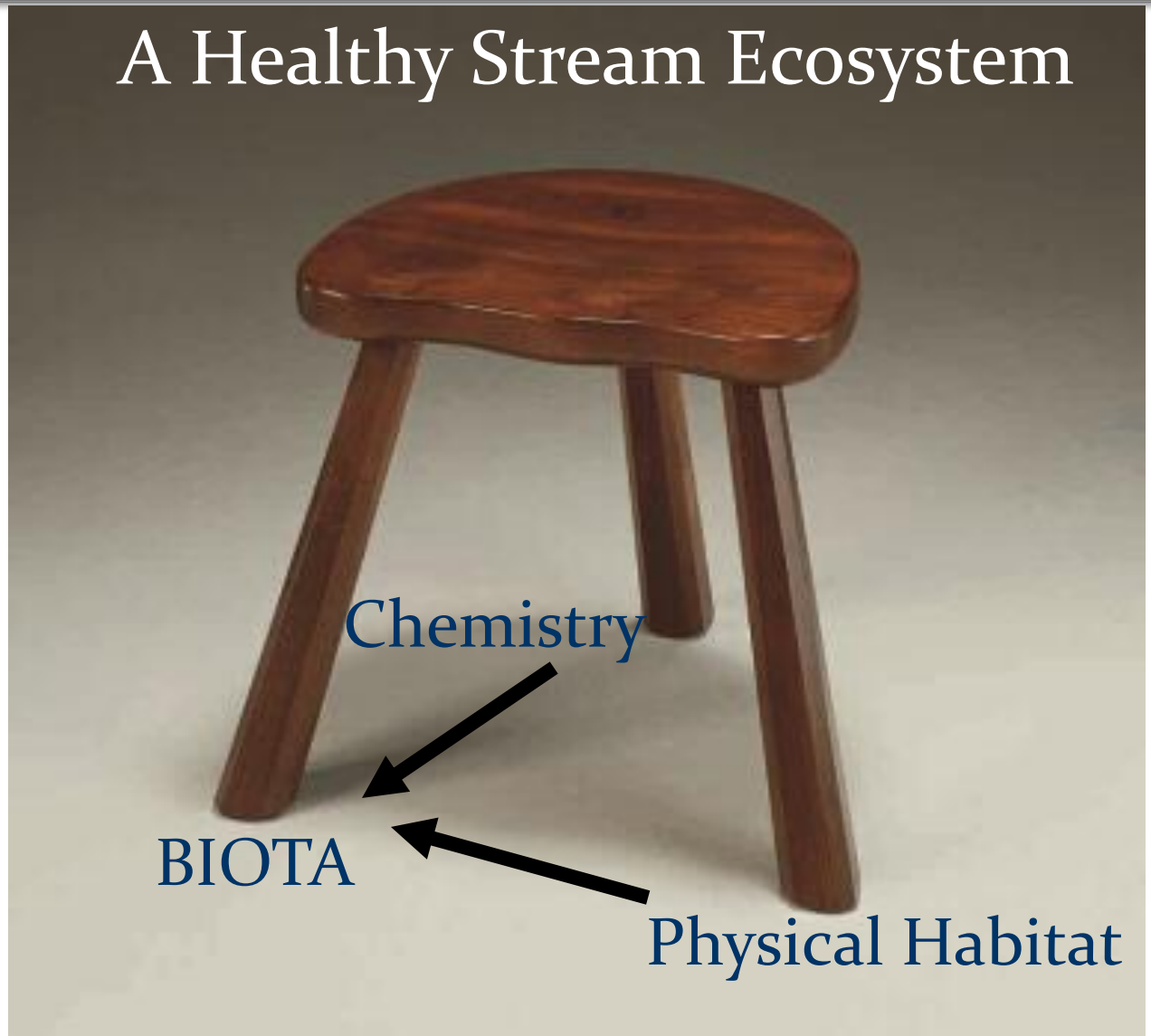
MARYLAND
DEPARTMENT OF
NATURAL RESOURCES

Stream Ecology:

The study of the physical, chemical and biological attributes of streams and the transitional areas adjacent to them.

Explore and Restore Maryland Streams

MARYLAND DEPARTMENT OF NATURAL RESOURCES



Explore and Restore Maryland Streams

MARYLAND DEPARTMENT OF NATURAL RESOURCES

Stream Functions Pyramid

1 Biology: *Amount, diversity, and life history* of animals and plants in the stream: Insects, fish, salamanders, algae.

2 Physiochemical: What are the *chemical* and *physical* characteristics of the *water*? Temperature, oxygen, conductivity, nutrients, pH.

3 Geomorphology/Habitat: The *physical environment* in and around the stream. Are diverse habitats available? How stable is the stream channel? Embeddedness, bank height, bank stability, amount of wood and rocks in the stream, riparian buffer width.

4 Hydraulics: The way the *water behaves* in the stream. Depth and speed of the water over time. How does the water interact with groundwater and the floodplain? Depth, flow, speed, volume.

5 Hydrology: *How much water* drains from the watershed into the stream. What is the land cover in the watershed? How much rain fell? Amount of pervious versus impervious surface in the watershed. Hydrograph.

Explore and Restore Maryland Streams

MARYLAND DEPARTMENT OF NATURAL RESOURCES

Explore and Restore Maryland Streams

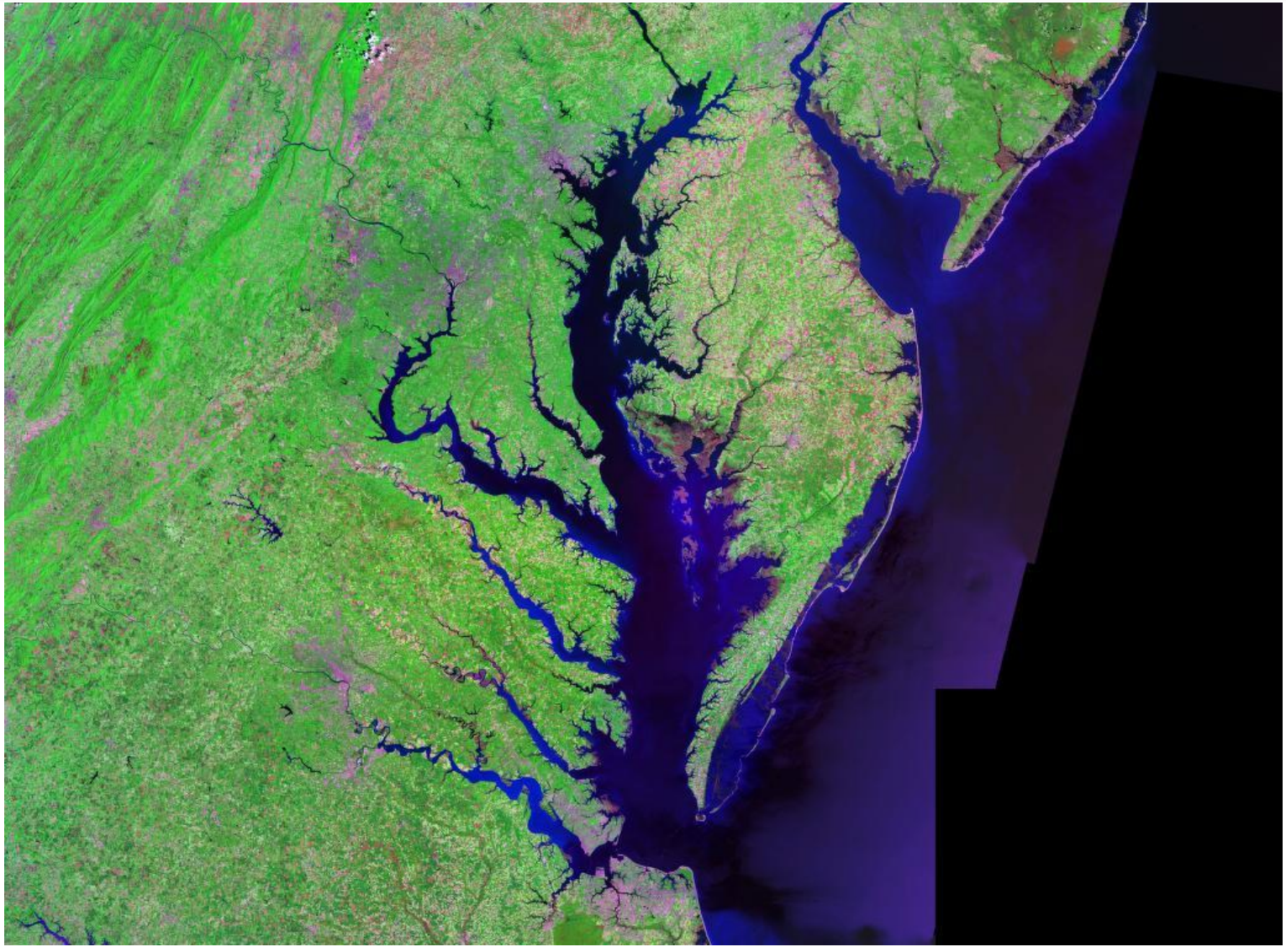
MARYLAND DEPARTMENT OF NATURAL RESOURCES

Explore and Restore Maryland Streams

MARYLAND DEPARTMENT OF NATURAL RESOURCES

Explore and Restore Maryland Streams

MARYLAND DEPARTMENT OF NATURAL RESOURCES



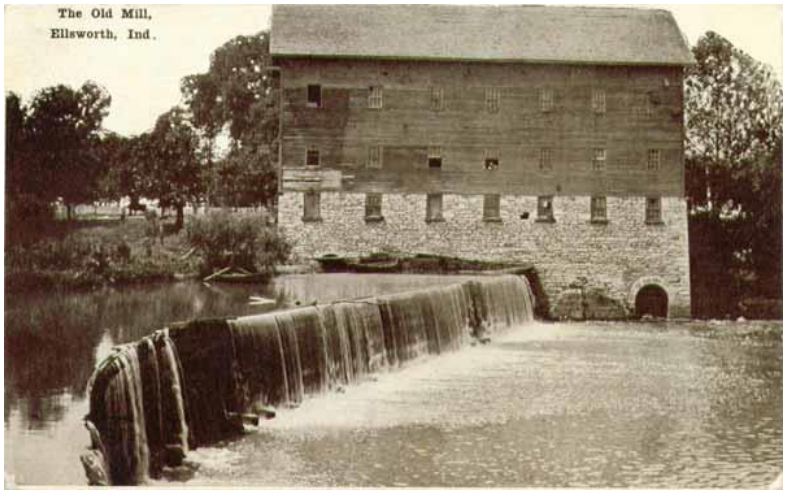
Explore and Restore Maryland Streams

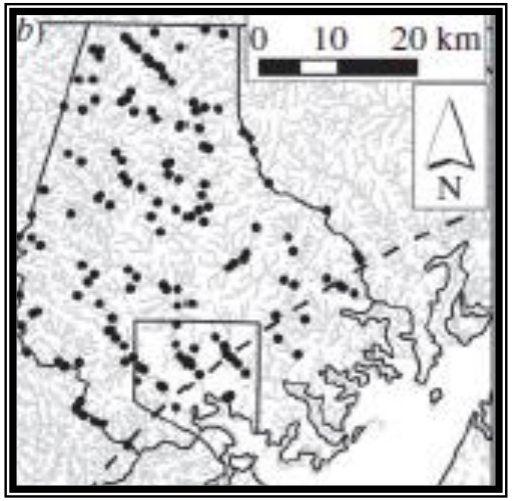
MARYLAND DEPARTMENT OF NATURAL RESOURCES

- Underground piping of streams
- Sedimentation/siltation
- Exotic/invasive species
- toxics
- Flood control
- logging
- mining
- Eutriphication/ nutrient enrichment
- Watershed imperviousness
- Water withdrawls
- construction
- Migration barriers
- Acid rain
- Road salt
- Thermal impacts
- Riparian zone destruction
- Road maintenance
- Recreational/commercial harvestation
- Stream "improvements"

Explore and Restore Maryland Streams

MARYLAND DEPARTMENT OF NATURAL RESOURCES





Explore and Restore Maryland Streams

MARYLAND DEPARTMENT OF NATURAL RESOURCES

MARYLAND
DEPARTMENT OF
NATURAL RESOURCES

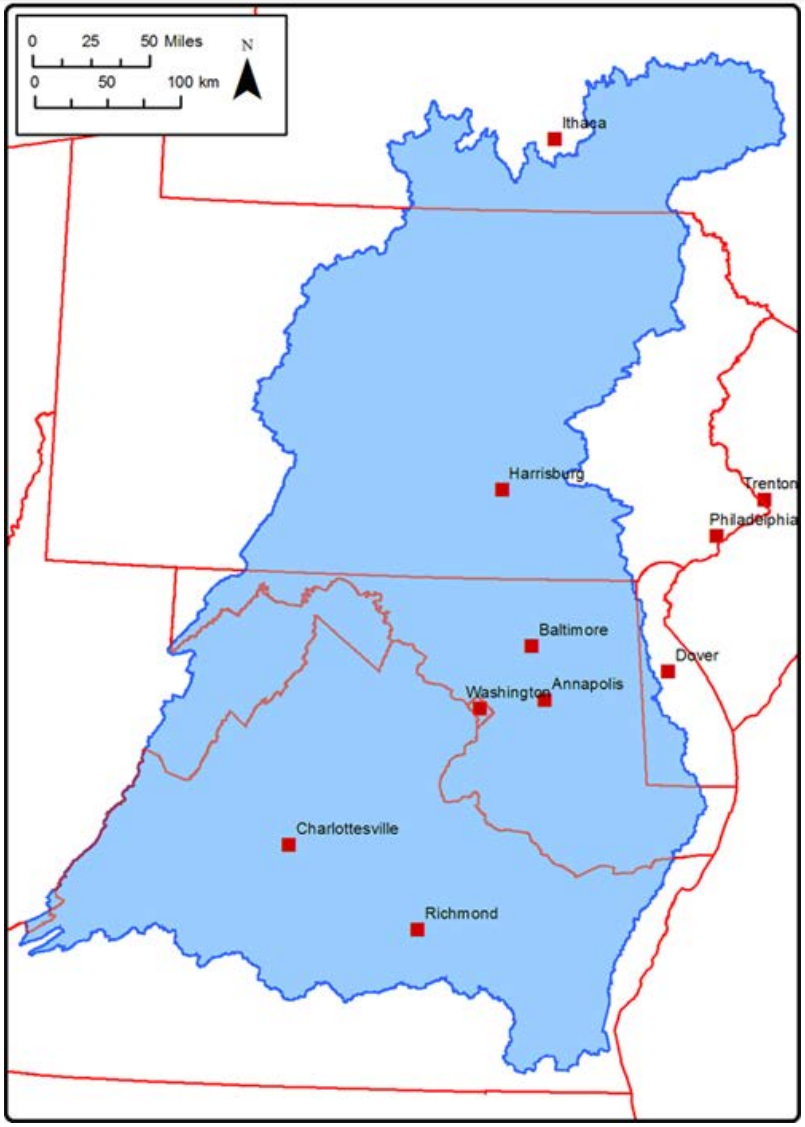
Geology and Scale

Explore and Restore Maryland Streams

MARYLAND DEPARTMENT OF NATURAL RESOURCES

Watershed- the area drained by a river or stream

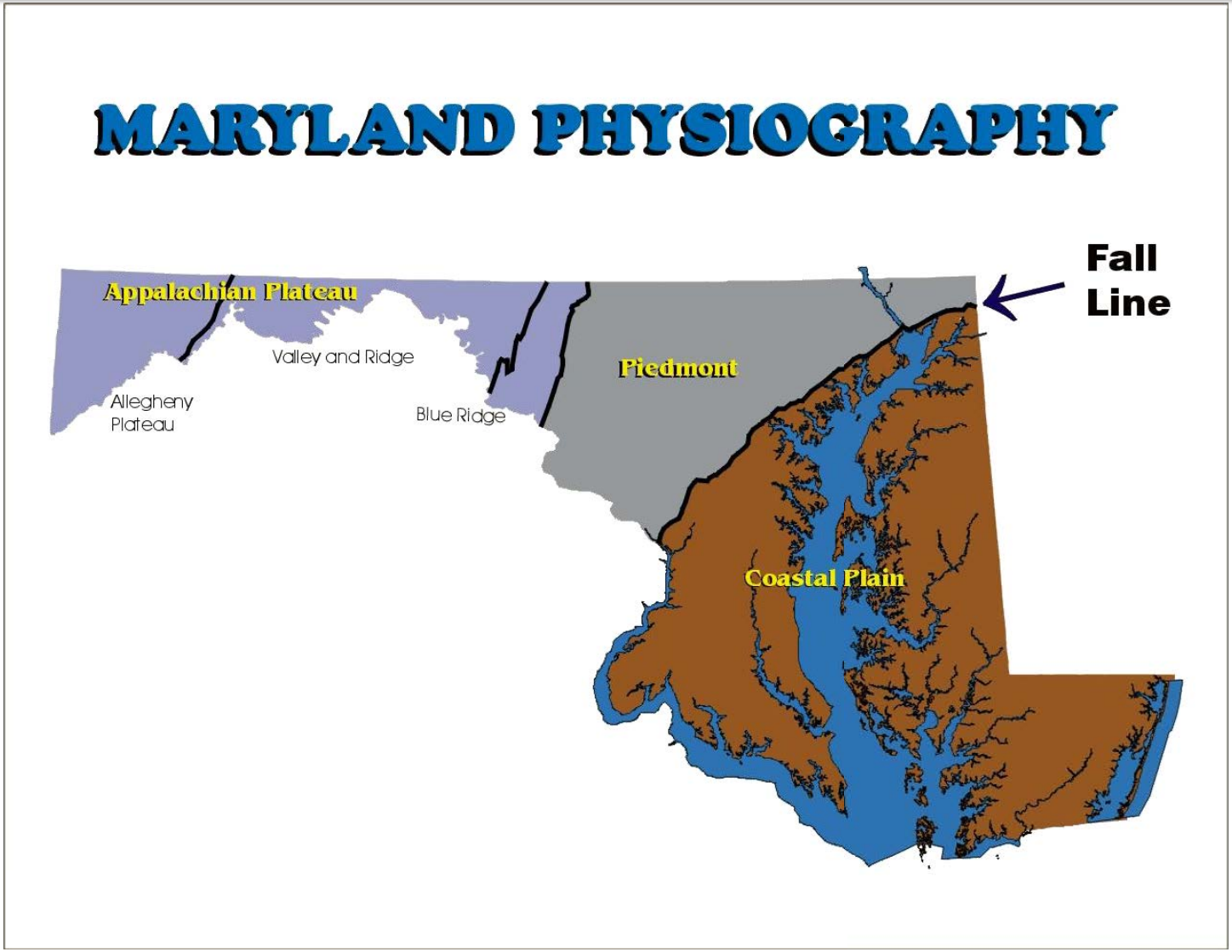
http://techalive.mtu.edu/meec/module01/whatiswatershed.htm



Cheasapeake Bay Watershed

Explore and Restore Maryland Streams

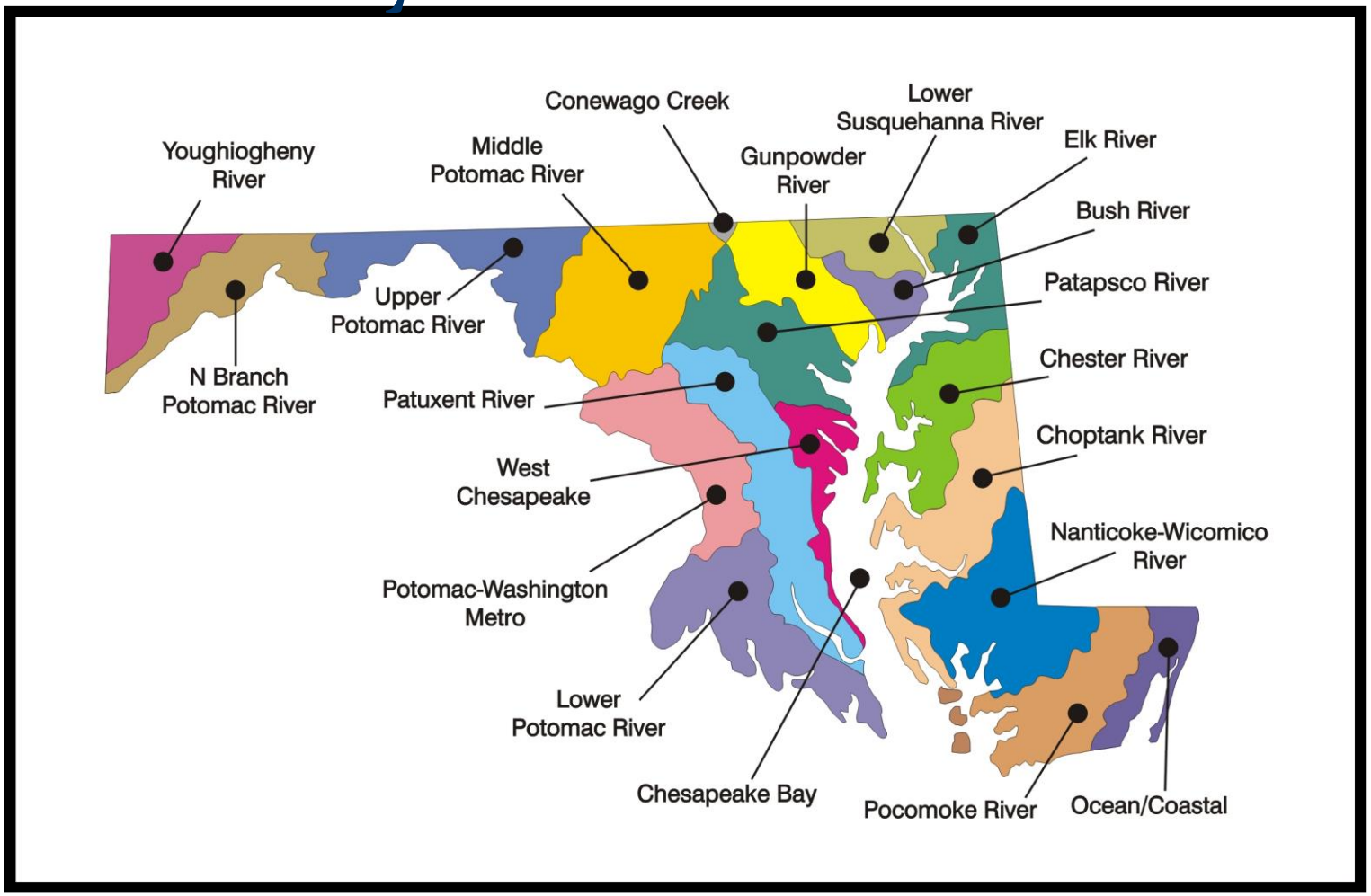
MARYLAND DEPARTMENT OF NATURAL RESOURCES



Explore and Restore Maryland Streams

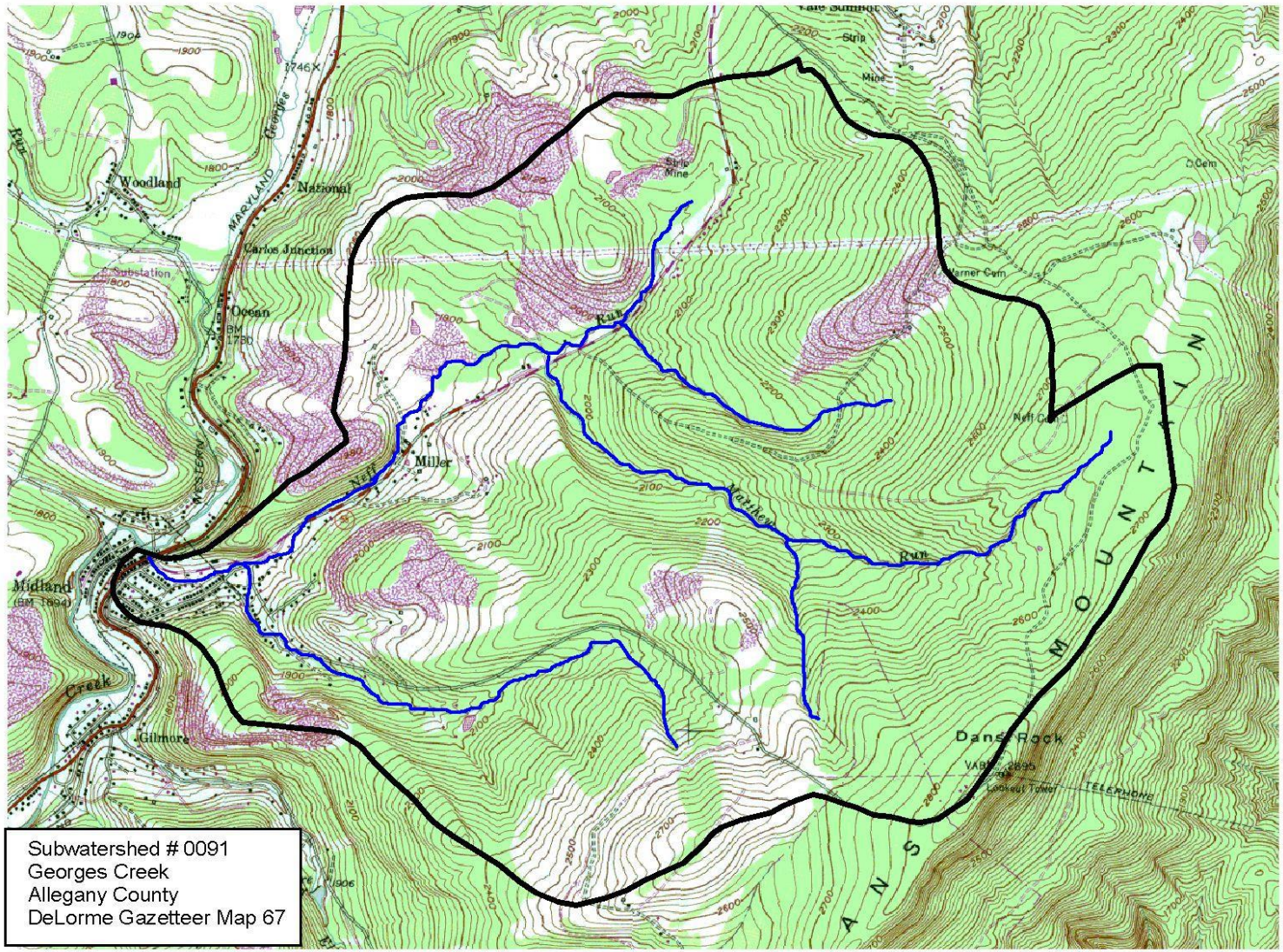
MARYLAND DEPARTMENT OF NATURAL RESOURCES

Maryland's River Basins



Explore and Restore Maryland Streams

MARYLAND DEPARTMENT OF NATURAL RESOURCES



MARYLAND
DEPARTMENT OF
NATURAL RESOURCES

Chemistry

MARYLAND
DEPARTMENT OF
NATURAL RESOURCES

Chemical Factors

- ***Temperature***
- ***Dissolved Oxygen (DO)***
- ***pH/Buffering Capacity***
- Conductivity
- Nutrients
- Sediment

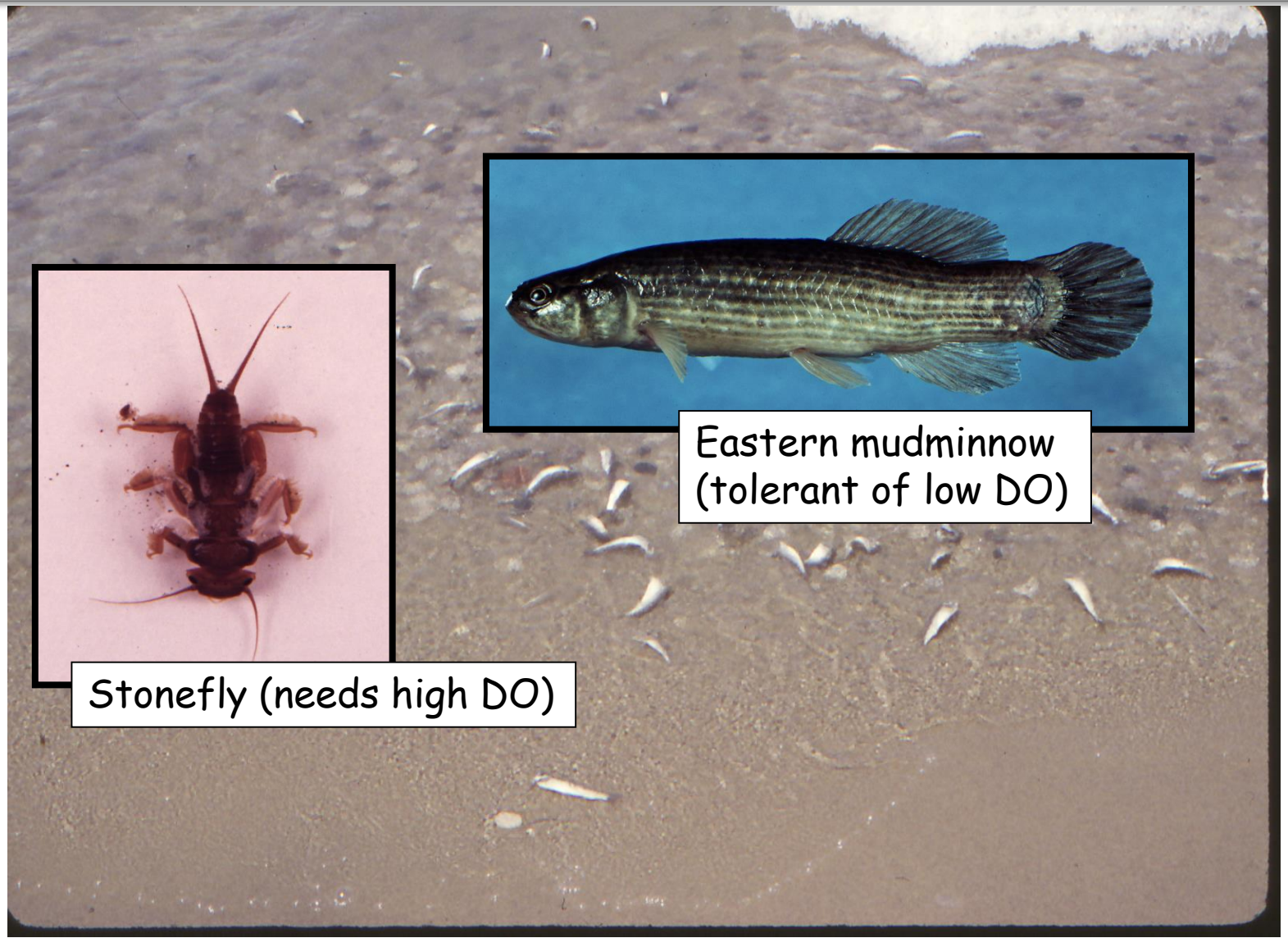
Explore and Restore Maryland Streams

MARYLAND DEPARTMENT OF NATURAL RESOURCES

- Higher water temperature = lower dissolved oxygen
- More canopy cover = lower water temperature = higher dissolved oxygen
- More riffles = higher dissolved oxygen

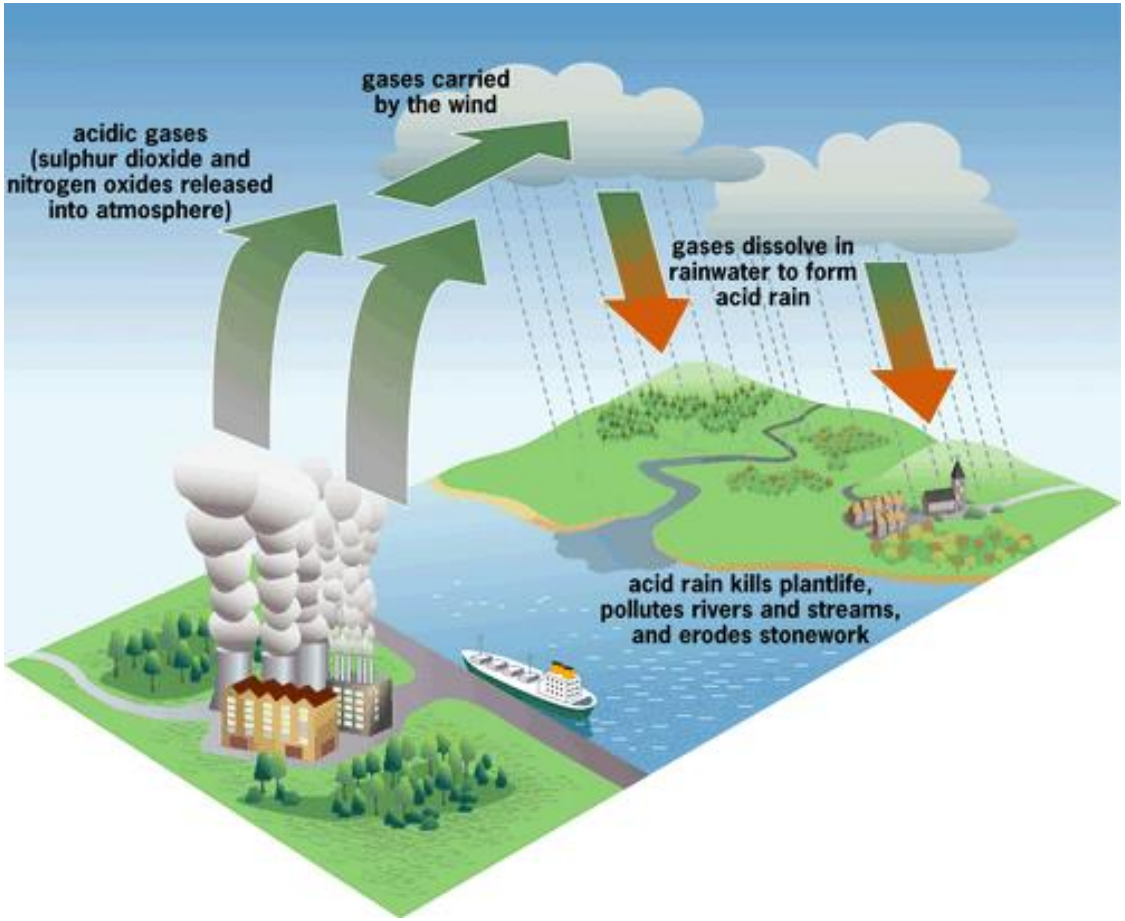
Explore and Restore Maryland Streams

MARYLAND DEPARTMENT OF NATURAL RESOURCES



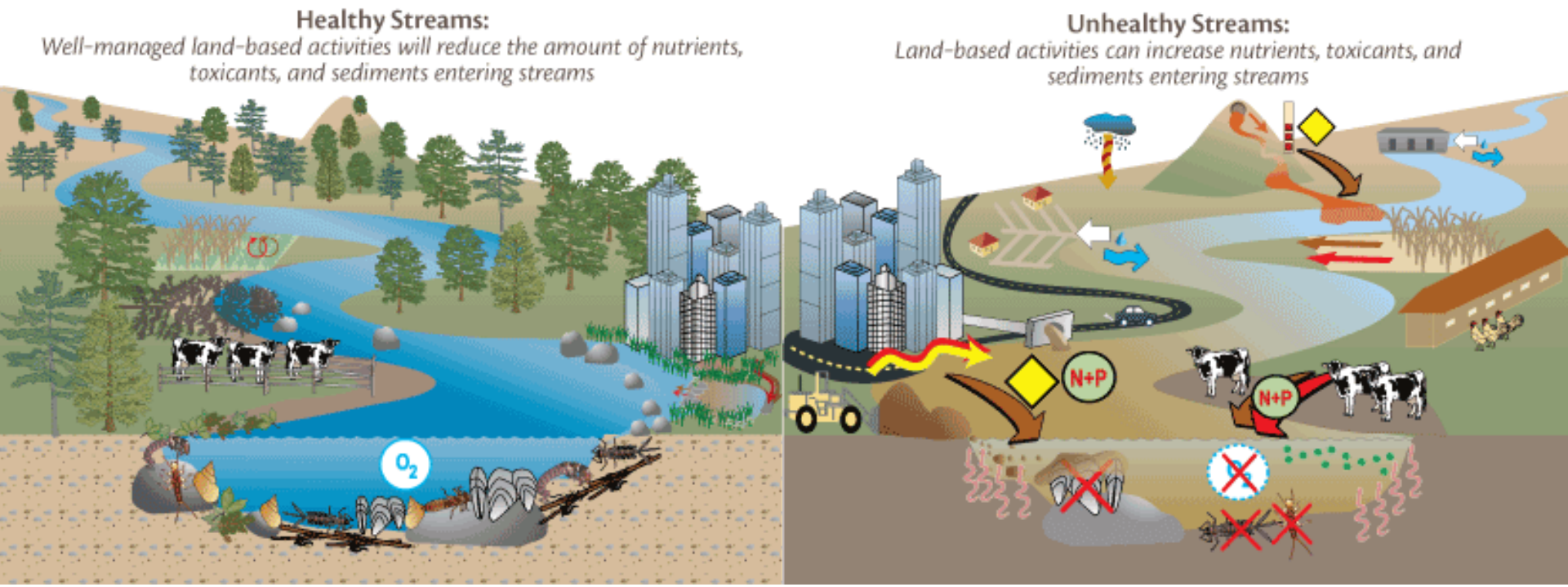
MARYLAND
DEPARTMENT OF
NATURAL RESOURCES

Acid Rain affects a stream's pH



Explore and Restore Maryland Streams

MARYLAND DEPARTMENT OF NATURAL RESOURCES



http://ian.umces.edu/ecocheck/report-cards/chesapeake-bay/2012/streamhealth/

Biology

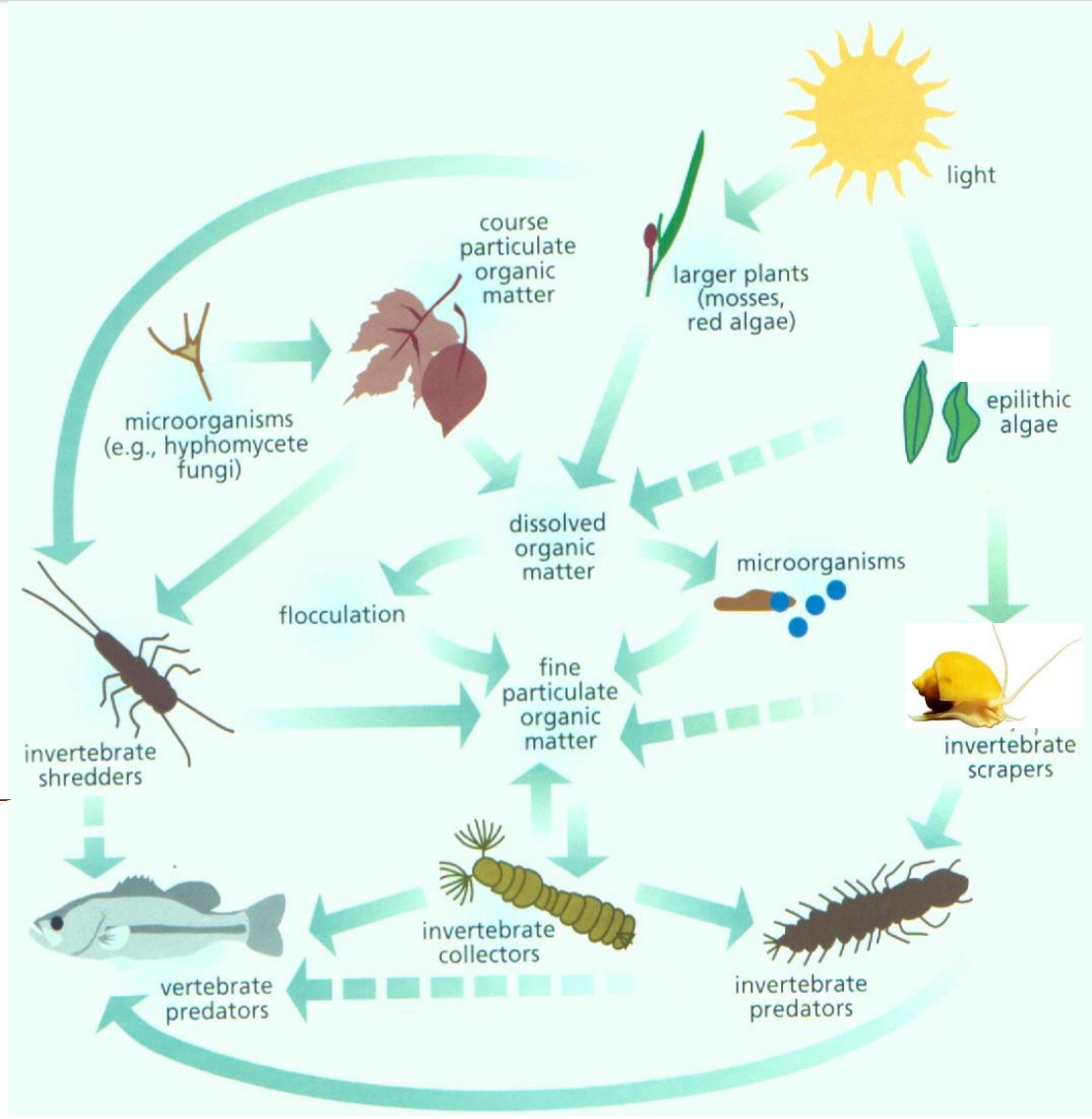
Explore and Restore Maryland Streams

MARYLAND DEPARTMENT OF NATURAL RESOURCES

Explore and Restore Maryland Streams

MARYLAND DEPARTMENT OF NATURAL RESOURCES

Stream Food Web



MARYLAND
DEPARTMENT OF
NATURAL RESOURCES

External (allochthonous) vs Internal (autochthonous) Energy Sources

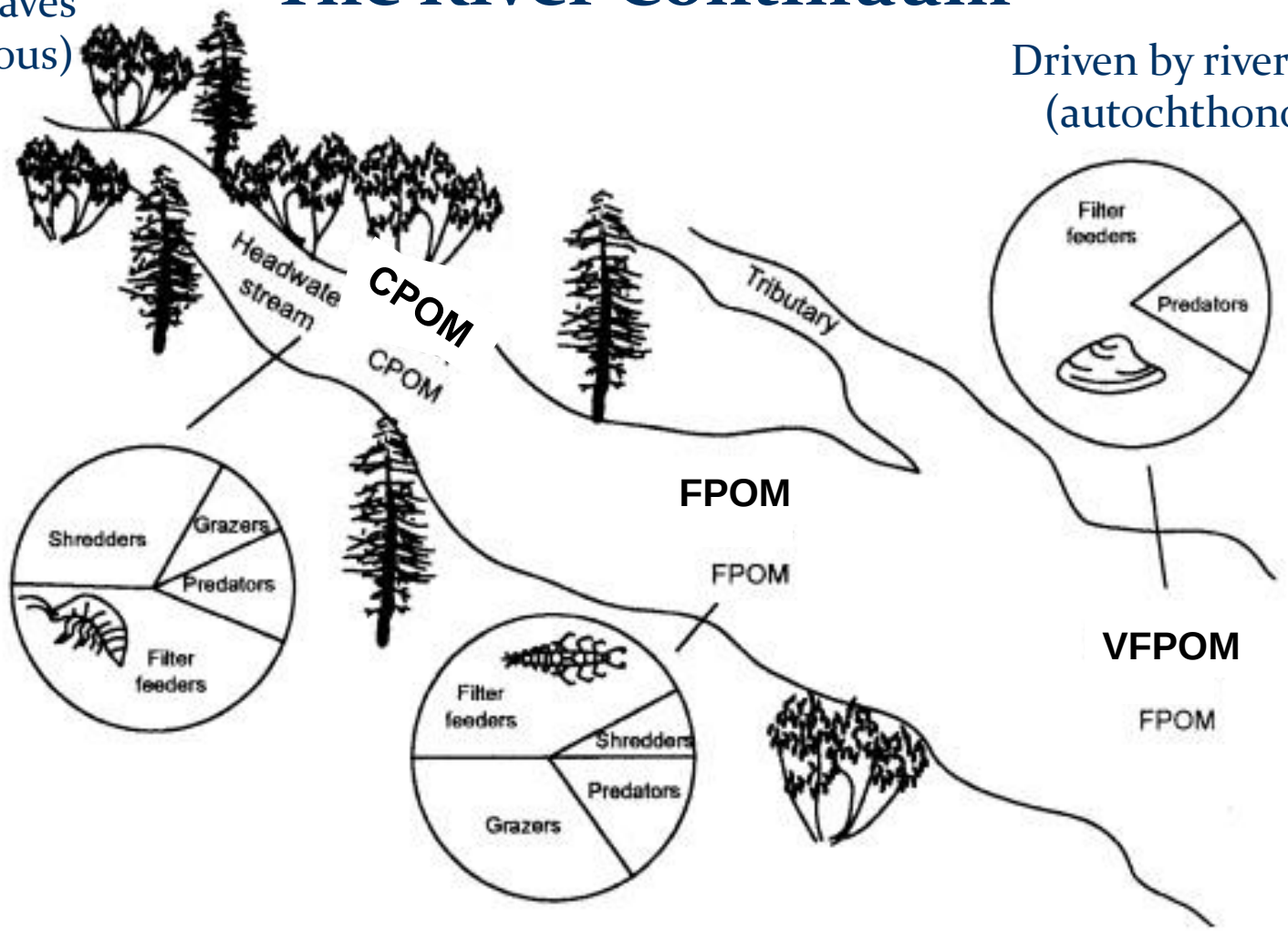
Explore and Restore Maryland Streams

MARYLAND DEPARTMENT OF NATURAL RESOURCES

The River Continuum

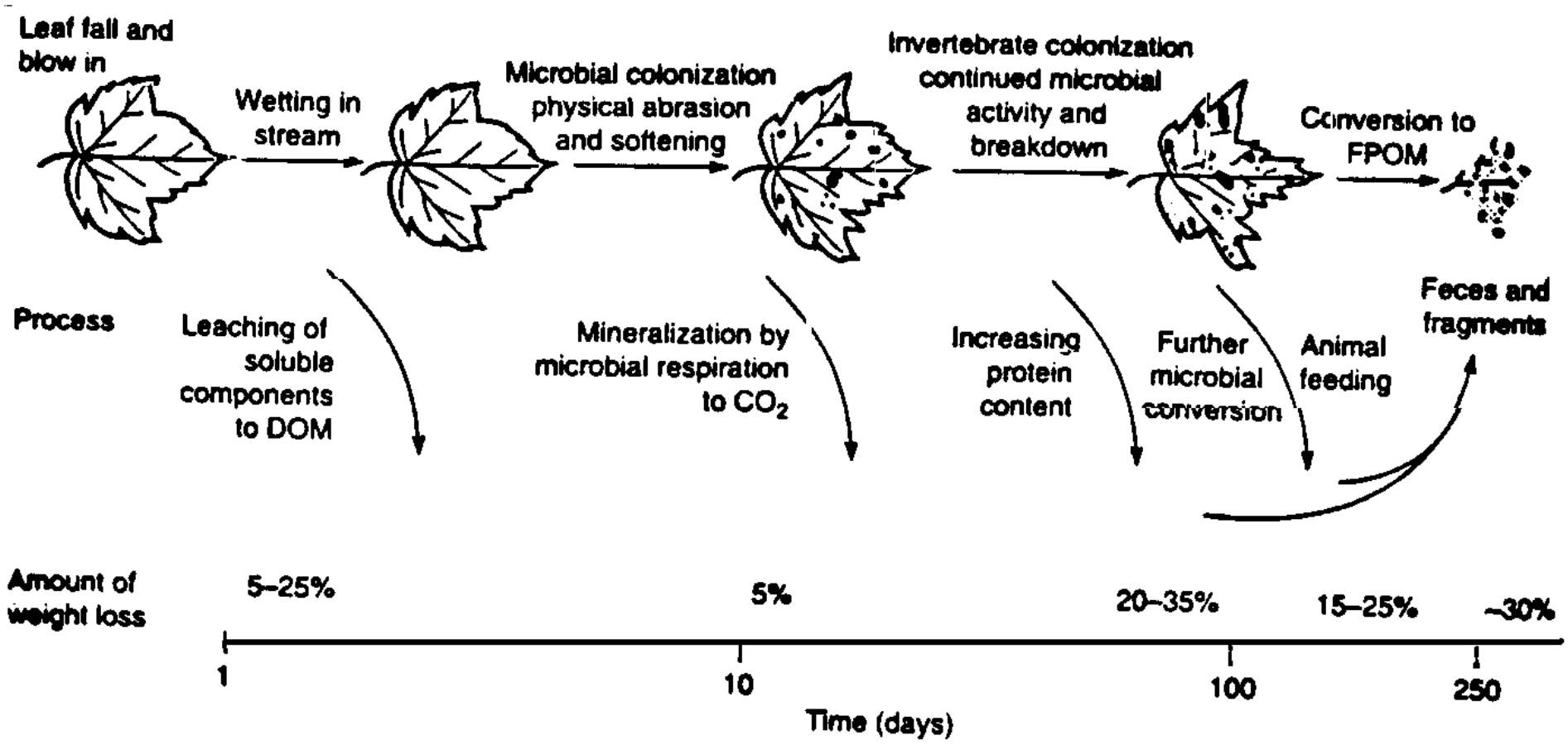
Driven by terrestrial leaves (allochthonous)

Driven by river algae (autochthonous)



MARYLAND
DEPARTMENT OF
NATURAL RESOURCES

Leaf Processing Sequence



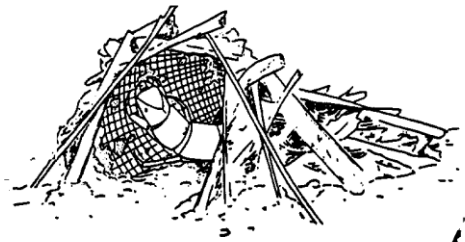
Explore and Restore Maryland Streams

MARYLAND DEPARTMENT OF NATURAL RESOURCES

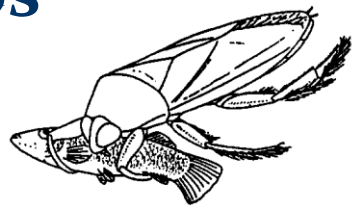
MARYLAND DEPARTMENT OF NATURAL RESOURCES

Benthic Feeding Groups

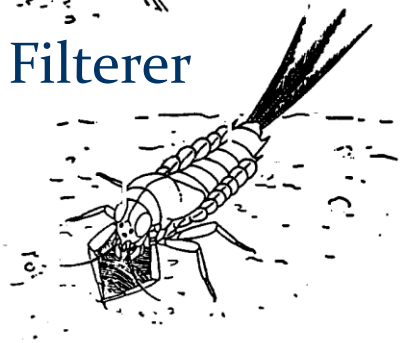
Borer



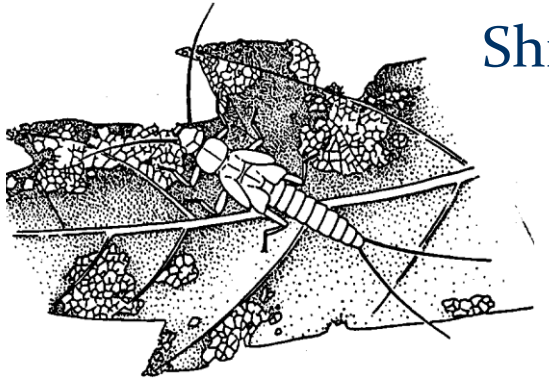
Piercer



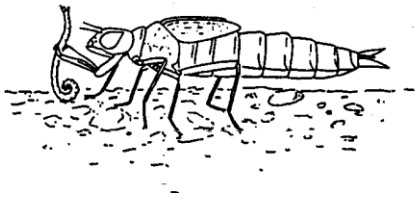
Filterer

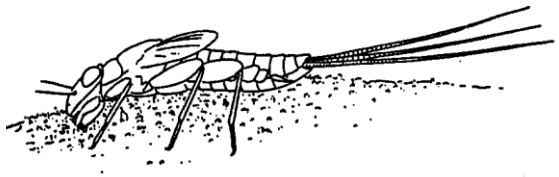


Shredder



Predator

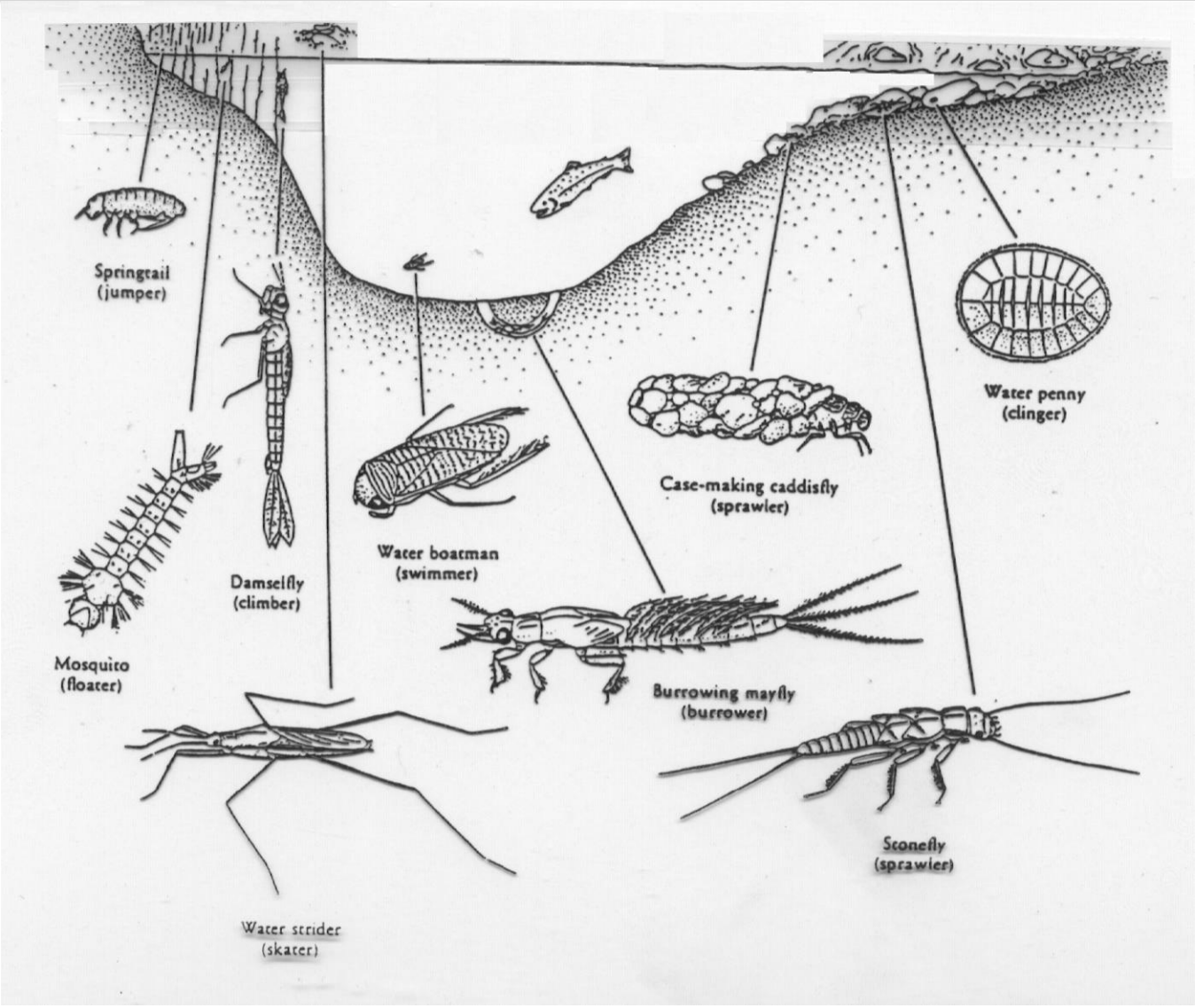




Scraper

Explore and Restore Maryland Streams

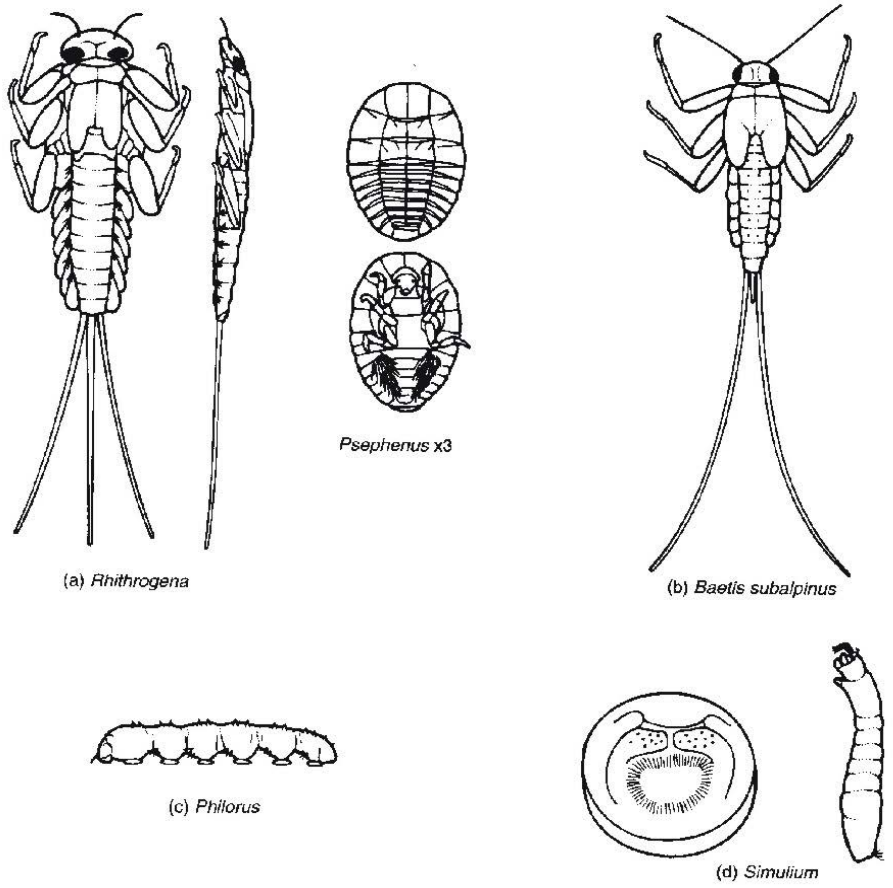
MARYLAND DEPARTMENT OF NATURAL RESOURCES



Habit

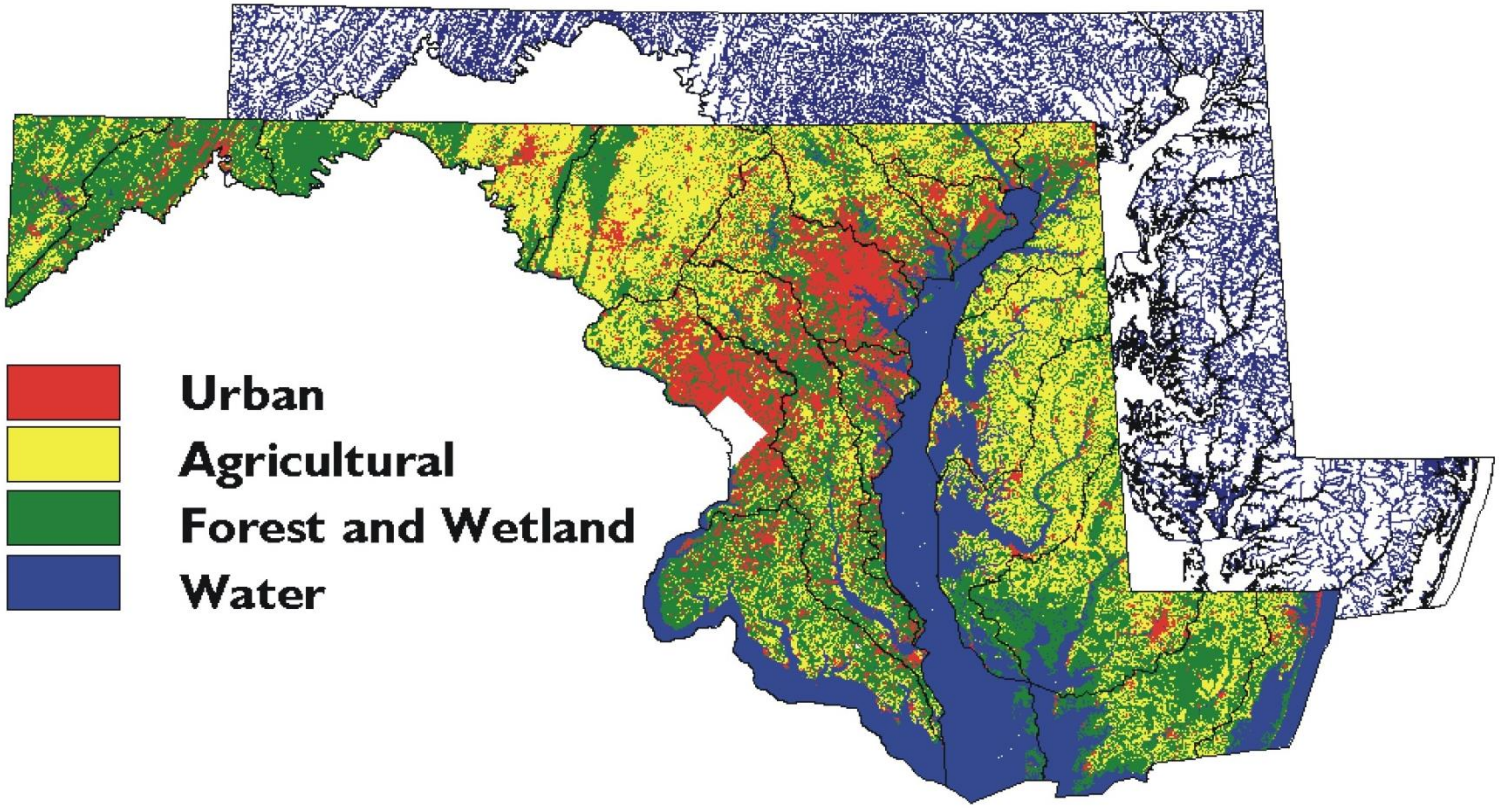
MARYLAND DEPARTMENT OF NATURAL RESOURCES

Invertebrate Adaptations to Life in Running Water



MARYLAND
DEPARTMENT OF
NATURAL RESOURCES

Land Use in Maryland



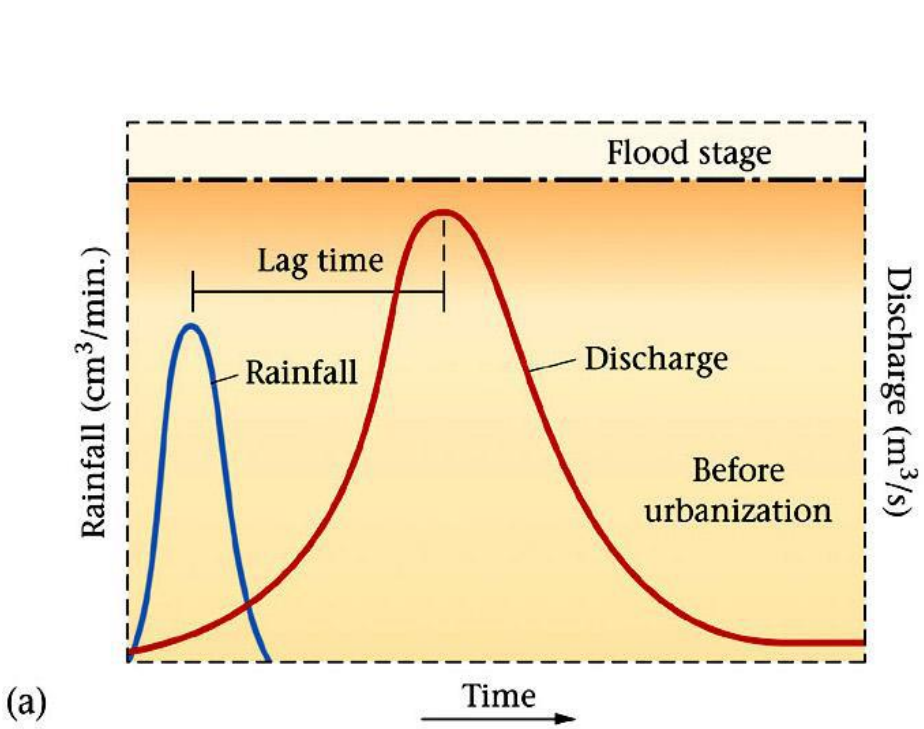
MBSS 1995-1997

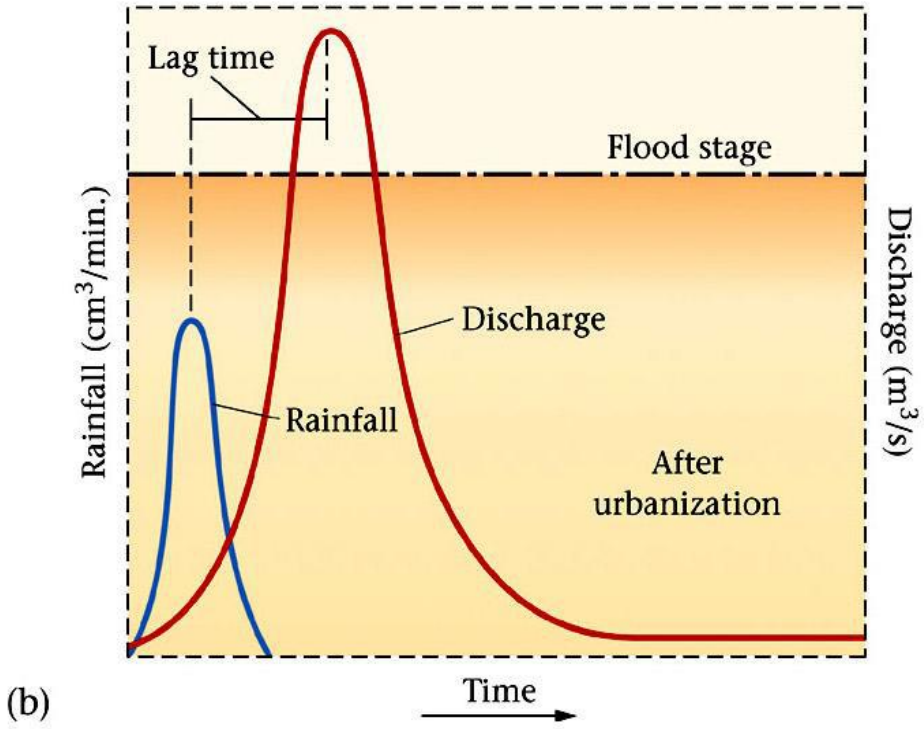
Explore and Restore Maryland Streams

MARYLAND DEPARTMENT OF NATURAL RESOURCES

MARYLAND DEPARTMENT OF NATURAL RESOURCES

Effects of **impervious surfaces** on streams

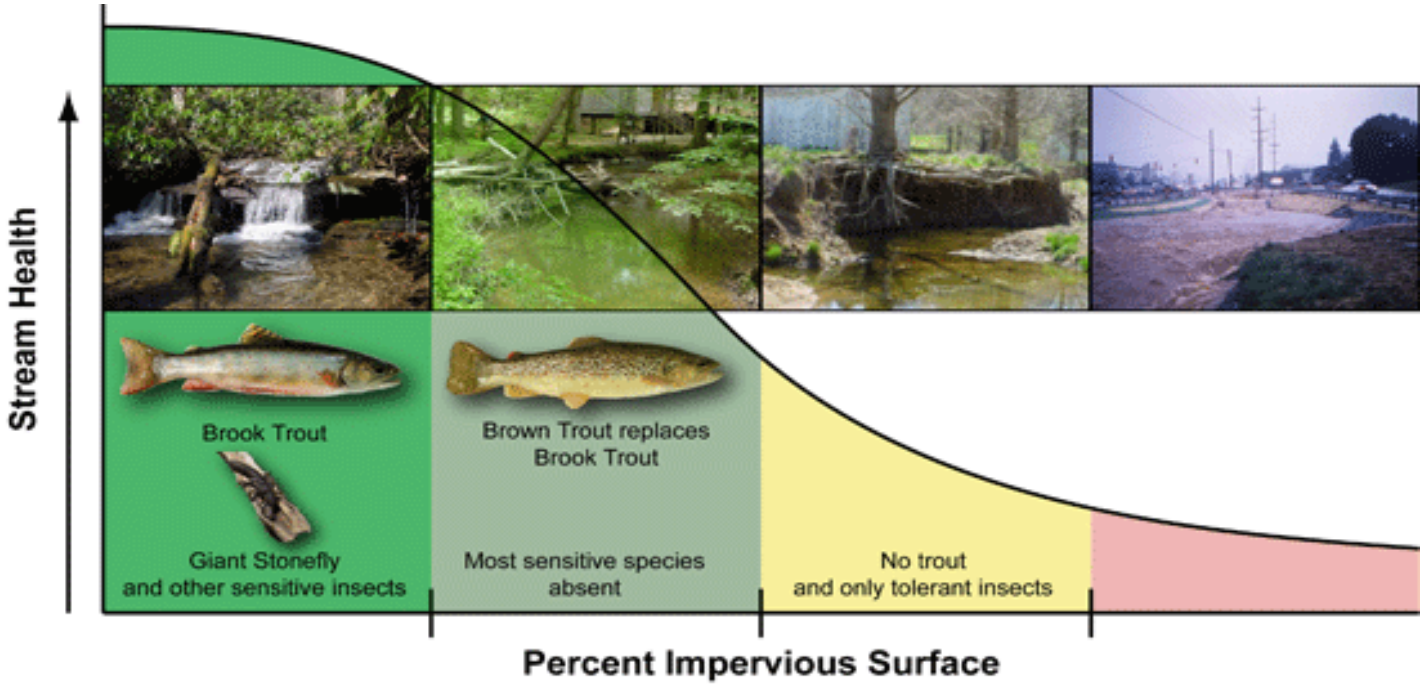




Explore and Restore Maryland Streams

MARYLAND DEPARTMENT OF NATURAL RESOURCES

Expected relationship between impervious surface and stream health



<5%	5-10%	10-20%	>20%
• Water cool and clean • Stream banks and bottom typically stable • Trout can be found • Endangered species can be found • Many fish species • Many salamander species • Many freshwater mussels • Many insect taxa	• Water may be warmer and slightly polluted • Erosion may be evident • No brook trout • Most rare and endangered species absent • Many pollution tolerant fish • Fewer salamander species • Only tolerant mussels • Fewer insect taxa	• Water warmer • Erosion usually obvious • Trout absent • Rare stream species absent • Fewer fish species • Only three tolerant salamander species • No native mussels • Mostly tolerant insects	• Water warm and pollution usually evident • Unstable habitat • Trout absent • Non-native species dominate some streams • Only tolerant fish species • One salamander species • No native mussels • Only tolerant insects

Explore and Restore Maryland Streams

MARYLAND DEPARTMENT OF NATURAL RESOURCES

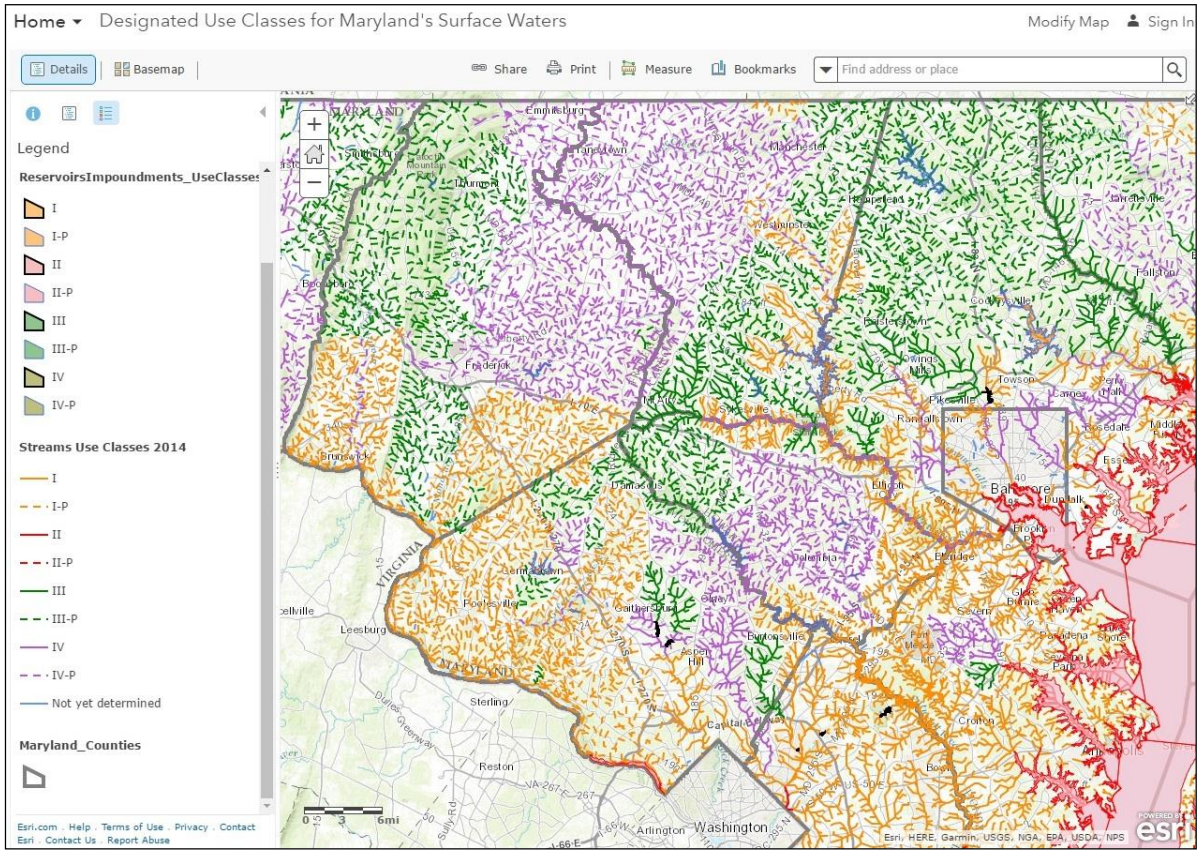
	Use Classes							
Designated Uses	I	I-P	II	II-P	III	III-P	IV	IV-P
Growth and Propagation of fish (not trout), other aquatic life and wildlife	✓	✓	✓	✓	✓	✓	✓	✓
Water Contact Sports	✓	✓	✓	✓	✓	✓	✓	✓
Leisure activities involving direct contact with surface water	✓	✓	✓	✓	✓	✓	✓	✓
Fishing	✓	✓	✓	✓	✓	✓	✓	✓
Agricultural Water Supply	✓	✓	✓	✓	✓	✓	✓	✓
Industrial Water Supply	✓	✓	✓	✓	✓	✓	✓	✓
Propagation and Harvesting of Shellfish			✓	✓				
Seasonal Migratory Fish Spawning and Nursery Use			✓	✓				
Seasonal Shallow-Water Submerged Aquatic Vegetation Use			✓	✓				
Open-Water Fish and Shellfish Use			✓	✓				
Seasonal Deep-Water Fish and Shellfish Use			✓	✓				
Seasonal Deep-Channel Refuge Use			✓	✓				
Growth and Propagation of Trout					✓	✓		
Capable of Supporting Adult Trout for a Put and Take Fishery							✓	✓
Public Water Supply		✓		✓		✓		✓

https://mde.maryland.gov/programs/Water/TMDL/WaterQualityStandards/Pages/wqs_designated_uses.aspx

Explore and Restore Maryland Streams

MARYLAND DEPARTMENT OF NATURAL RESOURCES

Check your stream's Maryland Designated Use Class!!



If your stream is Use Class III (green on the map) this means it could potentially be home to a breeding population of trout, and is subject to restrictions on activities that would disrupt the stream bed, such as benthic sampling. These restrictions are in effect October 1st- April 30th, but if you are sampling in September you are not subject to these restrictions.

https://mdewin64.mde.state.md.us/WSA/DesigUse/index.html

Or Google "Maryland use class streams"

Explore and Restore Maryland Streams

MARYLAND DEPARTMENT OF NATURAL RESOURCES

MARYLAND
DEPARTMENT OF
NATURAL RESOURCES

Getting to know your...

BUGS!

MARYLAND
DEPARTMENT OF
NATURAL RESOURCES

What are Benthic Macroinvertebrates?

- Associated with "bottom"*
- Visible to the naked eye
- >500 microns
- Fish food

* during some part of life cycle

MARYLAND DEPARTMENT OF NATURAL RESOURCES

Systematics (taxonomy) – the branch of Biology that deals with classification and nomenclature.

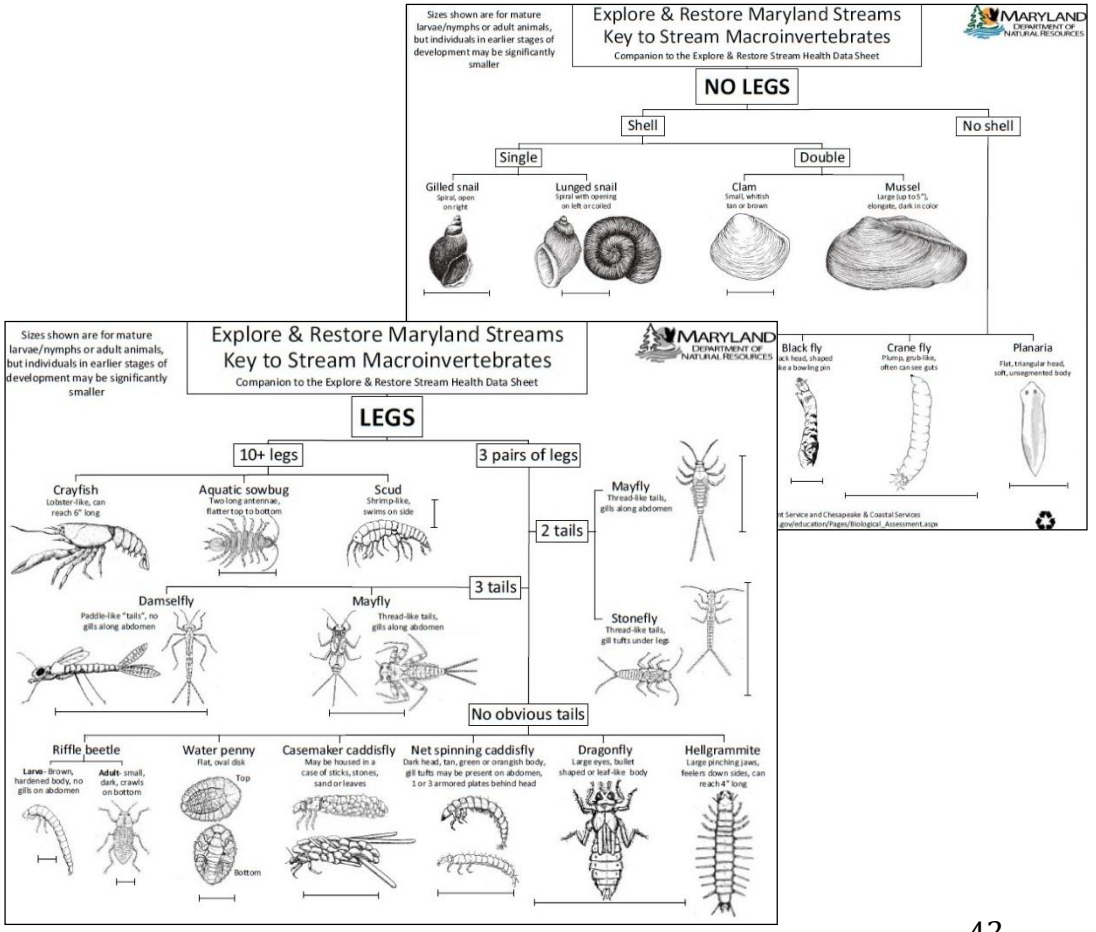
Kingdom
Phylum
Class
Order
Family
Genus
Species

Explore and Restore Maryland Streams

MARYLAND DEPARTMENT OF NATURAL RESOURCES

Role as Bioindicators

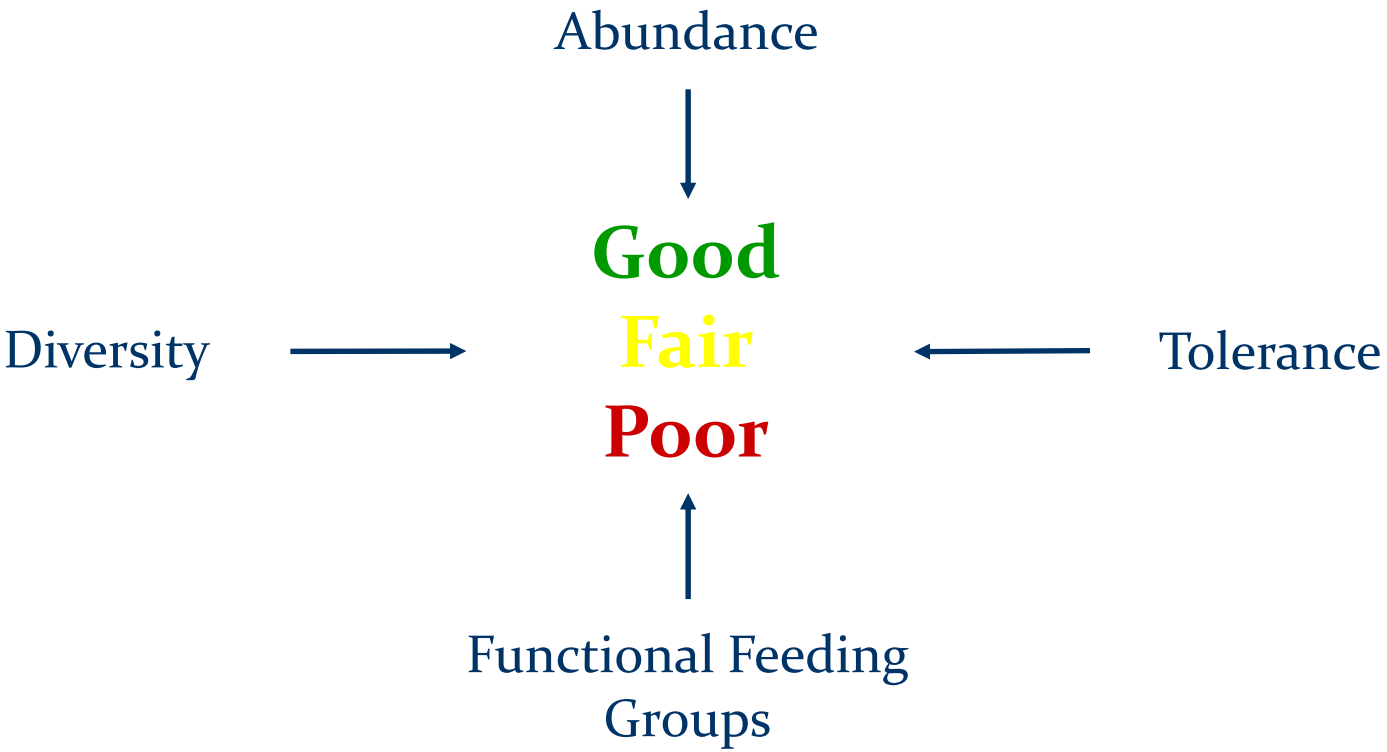
- Pollution sensitive
  - Dissolved oxygen, temperature, turbidity, etc.
- Easy and inexpensive to collect
- Useful in long-term monitoring



Explore and Restore Maryland Streams

MARYLAND DEPARTMENT OF NATURAL RESOURCES

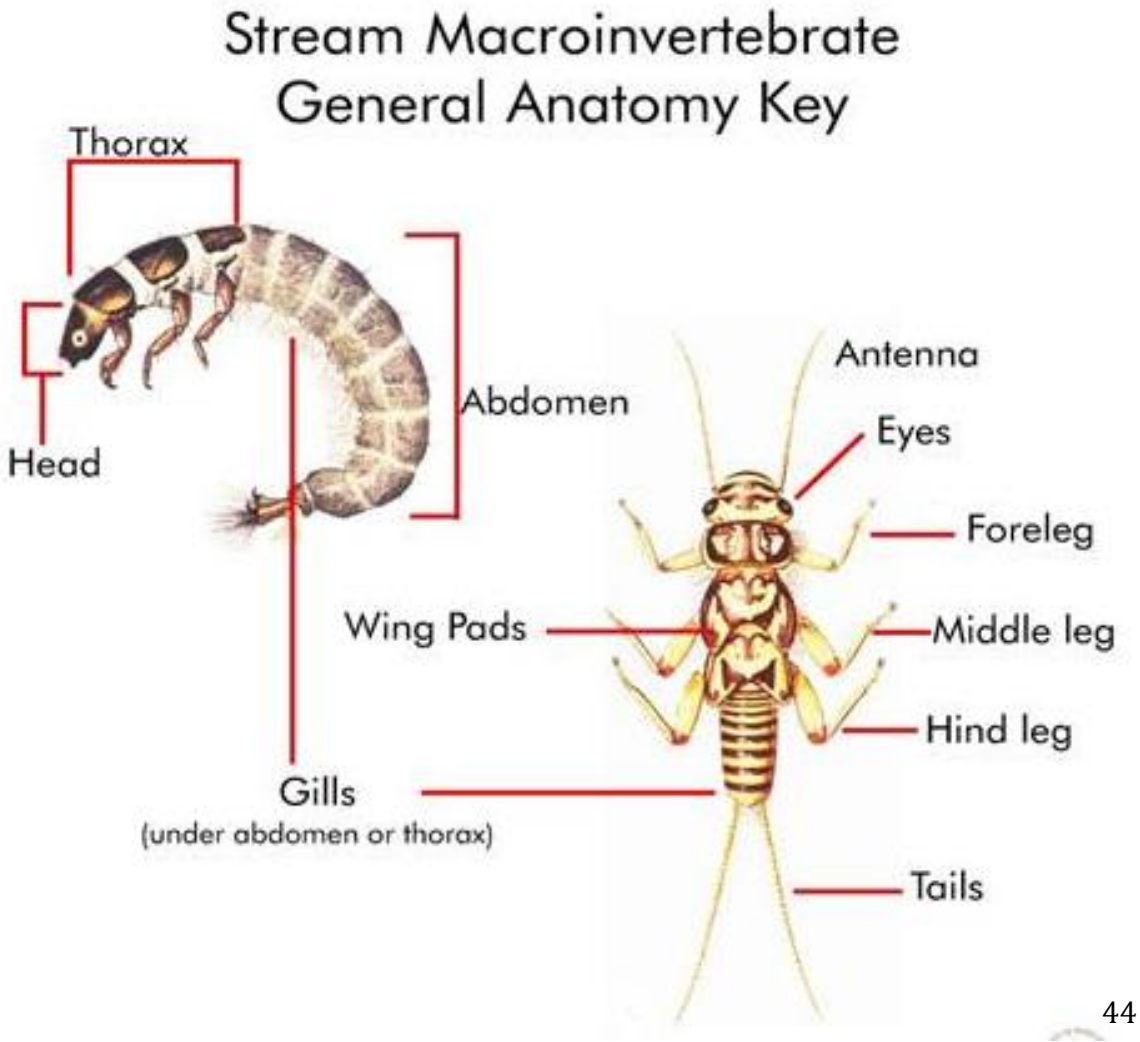
Index of Biotic Integrity (IBI)



Explore and Restore Maryland Streams

MARYLAND DEPARTMENT OF NATURAL RESOURCES

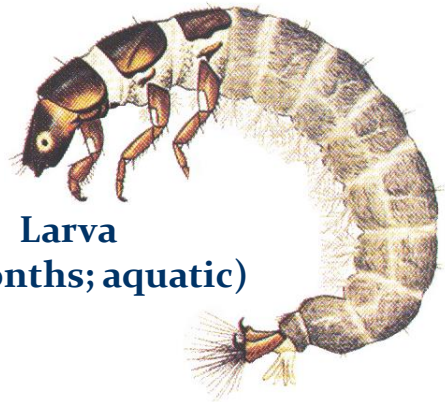
- 3 Major Body Parts
- Diagnostic Features:
  - Mouthparts
  - Legs
  - Abdomen length
  - Wing pads
  - Tails
  - Gills
  - Overall Shape



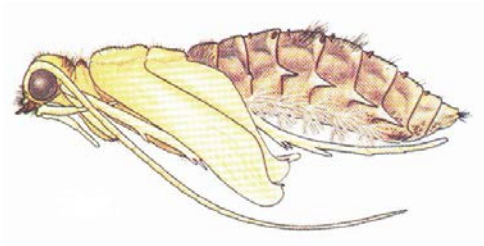
MARYLAND DEPARTMENT OF NATURAL RESOURCES

Life History of a Caddisfly (Complete Metamorphosis)

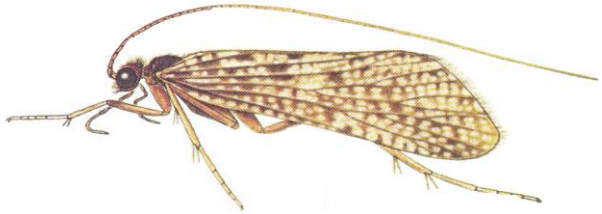
Egg
(1 week; aquatic)



Larva
(10 months; aquatic)



Pupa
(2 weeks; aquatic)



Adult
(1 month; terrestrial)

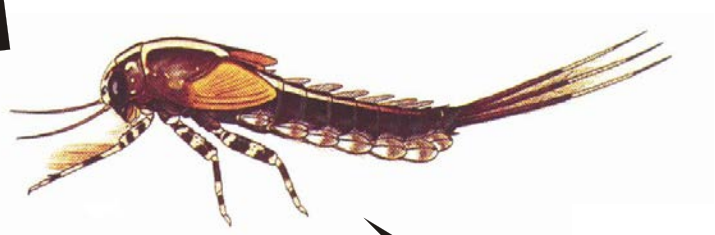
Explore and Restore Maryland Streams

MARYLAND DEPARTMENT OF NATURAL RESOURCES

Life History of a Mayfly

(Incomplete Metamorphosis)

Egg
(2 weeks; aquatic)



Nymph
(11 months; aquatic)

Adult
(2 days; terrestrial)

MARYLAND
DEPARTMENT OF
NATURAL RESOURCES

Benthic Macroinvertebrate Identification

Explore and Restore Maryland Streams

MARYLAND DEPARTMENT OF NATURAL RESOURCES

Biological Assessment: Macroinvertebrate Survey

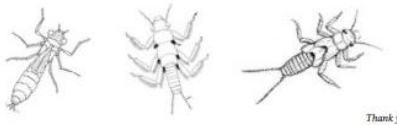
Collection method:

Kick-Seine or D-Net (circle method used).

If using a kick-seine, collect samples 3 times.

If using a D-net, collect 20 scoops and record the number of scoops taken from each of the habitat areas in the table →

Benthic Habitat Sampled	
Habitat	# scoops
Riffle	
Rootwads/ woody debris/ leaf pack	
Submerged Vegetation	
Undercut Banks	
Other (specify):	
TOTAL	20



Thank you to Howard County Public Schools System biology students for their contribution to the development of this tool. Howard County Conservancy

Check all of the macroinvertebrates that you find in your stream and calculate the stream's water quality rating *[you may also record the number of each captured, but to calculate the rating at the bottom, only count each kind of animal once, regardless of the quantity found].*

✓	Sensitive to pollution	✓	Less Sensitive to pollution	✓	Somewhat Tolerant to pollution	✓	Tolerant to pollution
	Casemaker caddisflies		Net spinning caddisflies		Clams		Aquatic sowbugs
	Mayflies		Crane flies		Mussels		Black flies
	Stoneflies		Dragonflies		Planaria		Midge flies
	Water pennies		Riffle beetles		Gilled snails		Leeches
	Hellgrammites				Crayfish		Lunged snails
					Scuds		Damselflies
							Aquatic worms
# of check marks _____		# of check marks _____		# of check marks _____		# of check marks _____	
# above x 3 = ____		# above x 2 = ____		# above x 1 = ____		# above x 0 = ____	

Biological Water Quality Rating:

Add up the numbers you calculated for all three categories, above. Write the total # here: _____

Circle the rating that corresponds to the total of your columns.

Good: > 22 **Fair: 17 - 22** **Marginal: 11 – 16** **Poor: < 11**

Explore and Restore Maryland Stream ratings correspond with the Maryland Biological Stream Survey and Maryland Stream Waders ratings of streams found on the Stream Health website. Stream sites rated **Good** are shown there in green, **Fair** sites are yellow, and **Marginal/Poor** sites are red.

MARYLAND DEPARTMENT OF NATURAL RESOURCES

Explore and Restore Maryland Streams

MARYLAND DEPARTMENT OF NATURAL RESOURCES

STONEFLY-Nymph

Sensitive

2 tails

Order – Plecoptera

A

Explore and Restore Maryland Streams

MARYLAND DEPARTMENT OF NATURAL RESOURCES

A

Explore and Restore Maryland Streams

MARYLAND DEPARTMENT OF NATURAL RESOURCES

STONEFLY - Adult

Order – Plecoptera

http://vimeo.com/90024767

Explore and Restore Maryland Streams

MARYLAND DEPARTMENT OF NATURAL RESOURCES

MAYFLY-
Nymph
Sensitive

Order –

Ephemeroptera

B

B

Explore and Restore Maryland Streams

MARYLAND DEPARTMENT OF NATURAL RESOURCES

In classical mythology nymphs were nature spirits often inhabiting rivers, streams and lakes.

https://www.youtube.com/watch?v=kB6RmFCmBoE

B

Explore and Restore Maryland Streams

MAYFLY – Adult

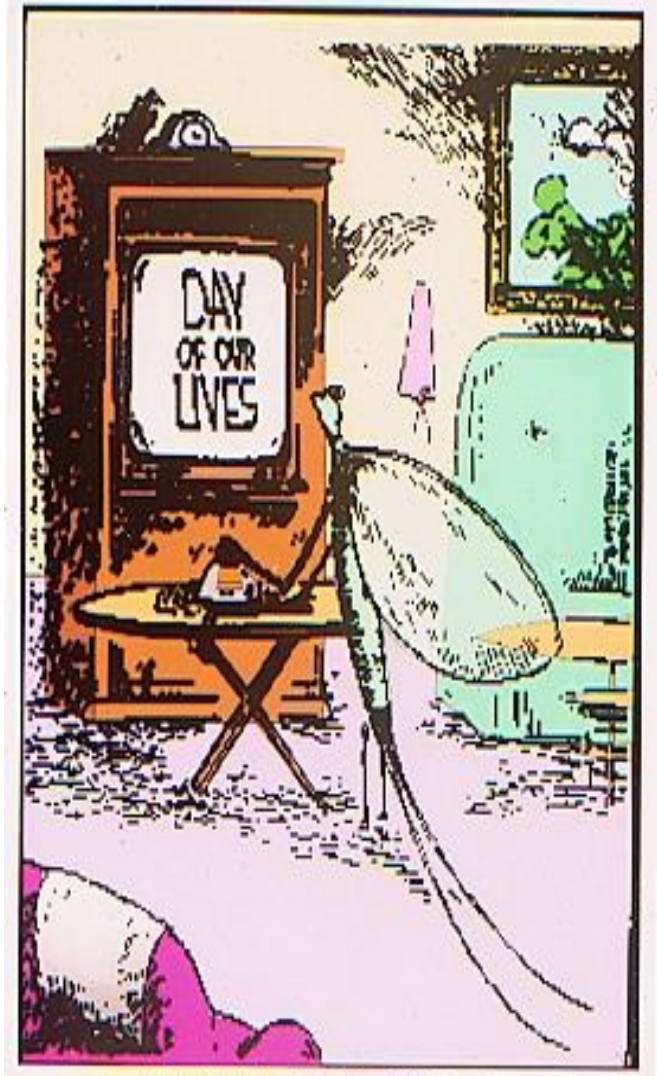
Order – Ephemeroptera

http://vimeo.com/90024047

Explore and Restore Maryland Streams

MARYLAND DEPARTMENT OF NATURAL RESOURCES

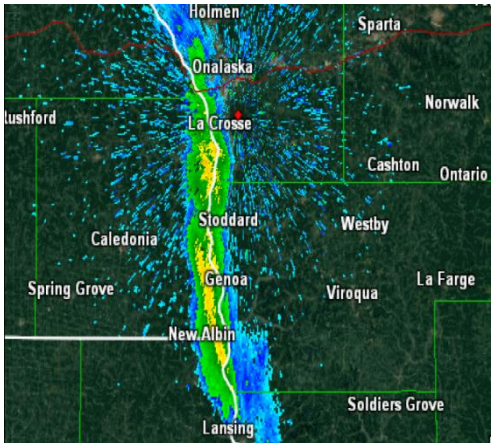
The order name Ephemeroptera translates to “short winged life”. Though they may spend over a year as a nymph, most species only live a day or two as adults, so they must find a mate quickly and reproduce before they die.



MAYFLY SOAP OPERAS

Explore and Restore Maryland Streams

When insects hatch in large swarms they overwhelm their predators so that many escape to reproduce. In 2014, there was a particularly large mayfly hatch in Wisconsin.



The hatch showed up on radar…

caused headaches for locals…

and was even blamed for a 3-car pile up.

http://www.huffingtonpost.com/2014/07/23/mayfly-hatch-wisconsin-photos-radar_n_5614449.html

Explore and Restore Maryland Streams

MARYLAND DEPARTMENT OF NATURAL RESOURCES

Stonefly vs. Mayfly

A

B

Explore and Restore Maryland Streams

MARYLAND DEPARTMENT OF NATURAL RESOURCES

CADDISFLY-

Case builder

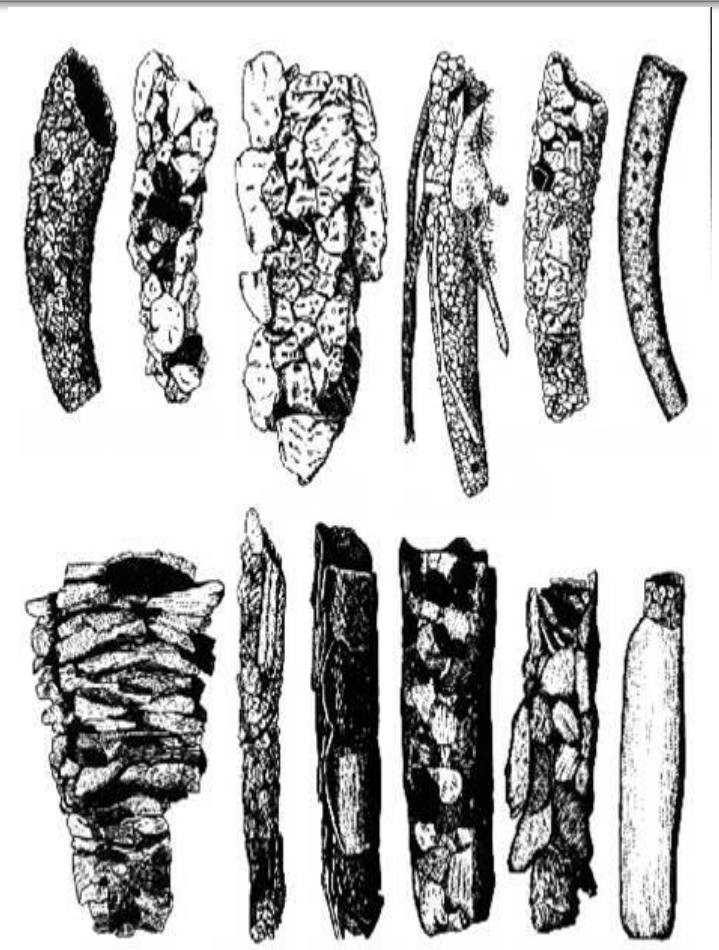
Sensitive

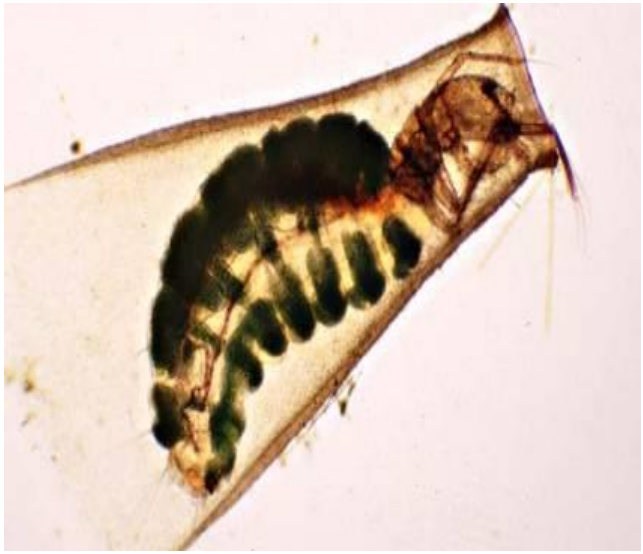
Order – Trichoptera

C

Explore and Restore Maryland Streams

Explore and Restore Maryland Streams





The structure of the case and the materials used in its construction varies among species.

MARYLAND
DEPARTMENT OF
NATURAL RESOURCES

CADDISFLY-

Net spinner

Less Sensitive

Order –
Trichoptera

D

Explore and Restore Maryland Streams

Some species of caddisflies build nets instead of cases. They use these nets to catch food (plankton, smaller insects). One caddisfly may build several nets which it will travel between to collect and eat its catch.

D

Explore and Restore Maryland Streams

Explore and Restore Maryland Streams

Fingernet caddisfly

MARYLAND
DEPARTMENT OF
NATURAL RESOURCES

CADDISFLY - Adult

Order – Trichoptera

http://vimeo.com/90025213

Explore and Restore Maryland Streams

HELLGRAMMITE

Less Sensitive

Order- Megaloptera

AKA: toe biters

Large predators. Some species reach 5 inches long. Capable of delivering a strong pinch. Feelers on abdomen are for respiration.

E

MARYLAND
DEPARTMENT OF
NATURAL RESOURCES

DOBSONFLY

(ADULT HELLGRAMMITE)

Explore and Restore Maryland Streams

MARYLAND DEPARTMENT OF NATURAL RESOURCES

Water Penny – Larva

Sensitive

Adult

Order – Coleoptera

F

Explore and Restore Maryland Streams

MARYLAND DEPARTMENT OF NATURAL RESOURCES

Water penny larvae generally like cold, fast moving water and are usually found in riffles where their flattened shape allows them to cling to the rocks without being swept away.

F

Explore and Restore Maryland Streams

MARYLAND DEPARTMENT OF NATURAL RESOURCES

Riffle beetles are one of the few benthic insects that live in the stream in both larval and adult form. The adults are lunged and are capable of carrying bubbles of air under their elytra (wing covers) and will replenish their air supply from bubbles in riffles and on aquatic vegetation. They must leave the water when they emerge as adults in order for their exoskeleton to harden, but they may never have to return to the surface again after that.

G

MARYLAND
DEPARTMENT OF
NATURAL RESOURCES

Riffle beetle larva vs. Net spinner caddisfly

G D

Explore and Restore Maryland Streams

MARYLAND DEPARTMENT OF NATURAL RESOURCES

DRAGONFLY –
Nymph

Order – Odonata

Less Sensitive

H

Explore and Restore Maryland Streams

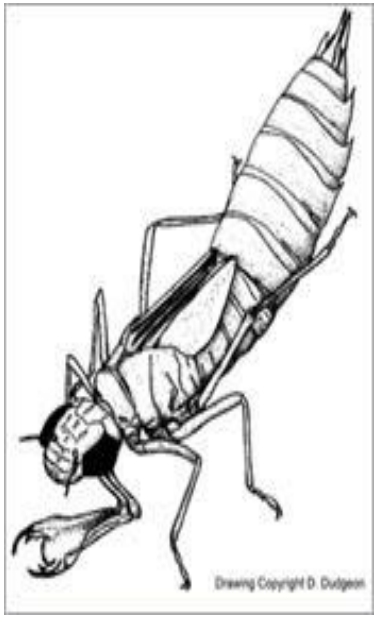
MARYLAND DEPARTMENT OF NATURAL RESOURCES

H

Explore and Restore Maryland Streams

MARYLAND DEPARTMENT OF NATURAL RESOURCES

Dragonfly and damselfly nymphs have a hinged mask over their mandibles that they can shoot out with remarkable speed to grab prey.



This is the stuff that nightmares are made of

Explore and Restore Maryland Streams

MARYLAND DEPARTMENT OF NATURAL RESOURCES

0:34s

Explore and Restore Maryland Streams

MARYLAND DEPARTMENT OF NATURAL RESOURCES

Adult

Nymph

Voracious predators as nymphs and as adults

H

Explore and Restore Maryland Streams

MARYLAND DEPARTMENT OF NATURAL RESOURCES

DAMSELFLY -

Nymph

Order – Odonata

Tolerant

3 paddle-like "tails" are actually the damselfly's gills.

I

Explore and Restore Maryland Streams

MARYLAND DEPARTMENT OF NATURAL RESOURCES

I

Explore and Restore Maryland Streams

MARYLAND DEPARTMENT OF NATURAL RESOURCES

Mayfly nymph vs. Damselfly nymph

B I

MARYLAND
DEPARTMENT OF
NATURAL RESOURCES

DAMSELFLY – Adult

Order – Odonata

Explore and Restore Maryland Streams

MARYLAND DEPARTMENT OF NATURAL RESOURCES

Order – Diptera

Adult

Cranefly- Larva

Less Sensitive

©MARLIN E. RICE

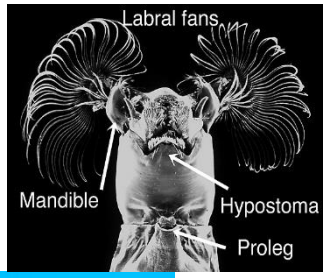
J

MARYLAND
DEPARTMENT OF
NATURAL RESOURCES

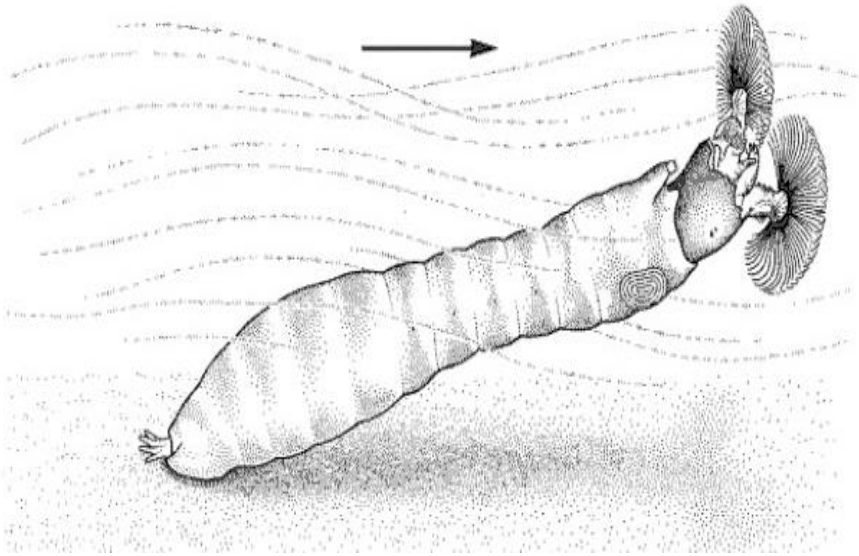
Blackfly- Larva

Tolerant

Order – Diptera



K



Blackfly larvae make a sticky silk pad on their posterior to anchor themselves to the substrate. They will open their labral fans to filter their food out of the water and then sweep their fan through their mouth to eat it.

MARYLAND DEPARTMENT OF NATURAL RESOURCES

NON-BITING MIDGE - Larva

Tolerant

Order – Diptera

L

Explore and Restore Maryland Streams

MARYLAND DEPARTMENT OF NATURAL RESOURCES

Adults look like mosquitoes, but do not bite.

Explore and Restore Maryland Streams

Increased pollution in Lake Victoria, Africa has led to drastic population decreases in fish species in the lake. With their predators removed, non-biting midges have been experiencing population explosions resulting in swarms of horrific proportions. The midges emerge from the lake as adults in massive smoke-like clouds that bring misery when they make landfall

...but also have a surprising upside.

https://www.youtube.com/watch?v=YcXsx8gpN9M

Explore and Restore Maryland Streams

MARYLAND DEPARTMENT OF NATURAL RESOURCES

Awesome Resource!

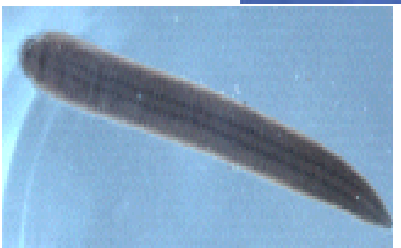
http://macroinvertebrates.org/

MARYLAND DEPARTMENT OF NATURAL RESOURCES

Other Phyla






- Subphylum **Crustacea**
  - Crayfish, Isopods, Amphipods
- Phylum **Mollusca**
  - Snails, Clams, Mussels
- Phylum **Annelida**
  - Segmented Worms (ie. leeches)

Explore and Restore Maryland Streams

MARYLAND DEPARTMENT OF NATURAL RESOURCES

Crustaceans

M

SCUDS →
(AMPHIPODS)
Somewhat Tolerant

← CRAYFISH
Somewhat Tolerant

AQUATIC SOWBUG →
Tolerant

N

O

MARYLAND DEPARTMENT OF NATURAL RESOURCES

Mollusks

CLAM
Somewhat
Tolerant

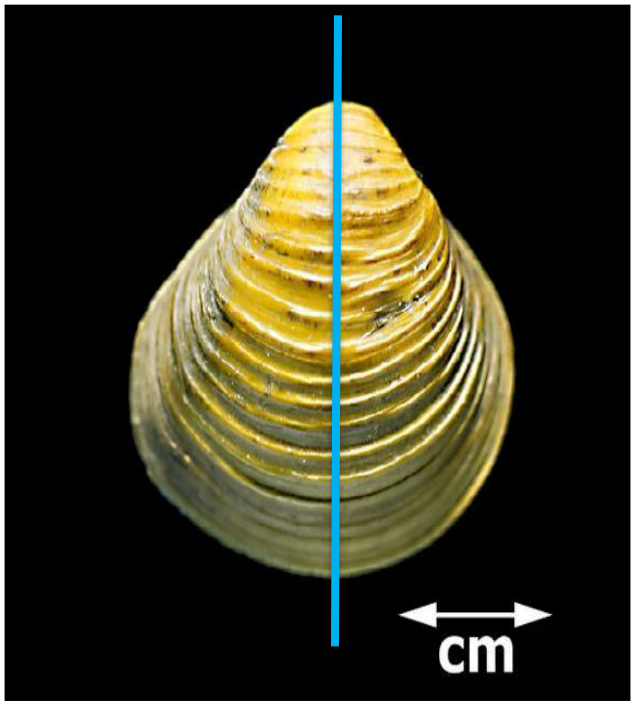
FRESHWATER MUSSEL
Somewhat
Tolerant

P

Explore and Restore Maryland Streams

MARYLAND DEPARTMENT OF NATURAL RESOURCES

Clam vs. Freshwater mussel



P

Explore and Restore Maryland Streams

MARYLAND DEPARTMENT OF NATURAL RESOURCES

Freshwater mussels: Deceptively fascinating

Almost all species of freshwater mussels use a fish host to spread their larvae, called glochidia (gluh-**kid**-ia). Their methods of transmission range from passive to deceptive to aggressive. By using a fish host as a vector of dispersal the mussel increases the chance that its offspring will not be too near to a parent and so will not be competition for resources.

https://www.youtube.com/watch?v=IoYTBjoWHkU

Left: A freshwater mussel displays a lure that bears an incredible likeness to a darter, enticing predatory fish to attack the lure and rupture the sac containing the glochidia. Right: The Northern Riffleshell mussel (not native to MD) clamps onto its intended host and holds it lightly while it inoculates the fish's gills with glochidia.

Explore and Restore Maryland Streams

0:47s

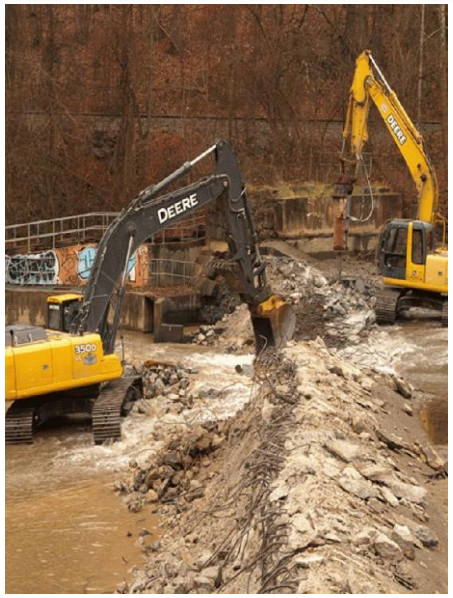
Explore and Restore Maryland Streams

MARYLAND DEPARTMENT OF NATURAL RESOURCES

Interesting work going on right here at home!

Bloede Dam on the Patapsco River is being removed! Removing Bloede Dam, the lowermost dam on the river, will open up more than 44 miles of spawning habitat for blueback herring, alewife and American shad, and more than 180 miles of habitat for American eel. The American eel is the host for Eastern elliptio mussel glochidia, so removal of the dam will open up all that habitat to the mussels as well.

https://www.americanrivers.org/patapsco/index.html



American eel (*Anguilla rostrata*)

Eastern elliptio (*Elliptio complanata*)

MARYLAND DEPARTMENT OF NATURAL RESOURCES

Identifying Right-handed vs. Left-handed snails

- Place the snail in your palm with the opening facing up and the umbo (spiral tip) pointing towards your fingers.
- If the opening is oriented to the right, it is a right-handed gilled snail and is sensitive to pollution.
- If the opening is oriented to the left, it is a left-handed lunged snail. The lunged snail has a sac-like lung, so it can escape out of the water for a short time if conditions are especially poor. This adaptation makes it pollution tolerant.

Gilled snail (right-handed) Somewhat Tolerant

Q

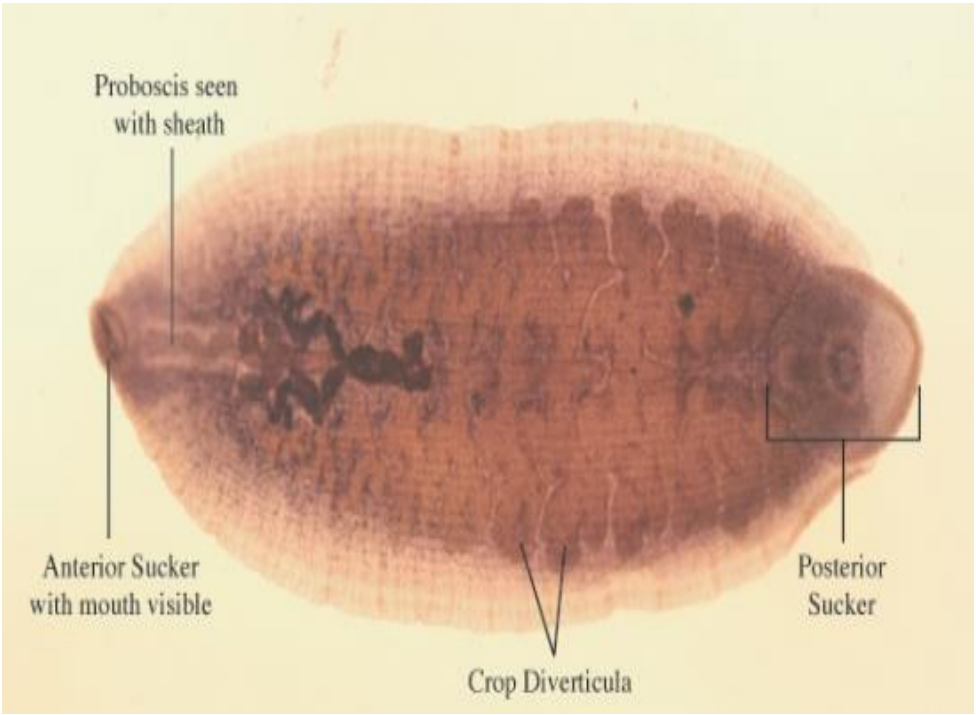
Lunged snail (left-handed) Tolerant

R

MARYLAND
DEPARTMENT OF
NATURAL RESOURCES

LEECH

Tolerant



Explore and Restore Maryland Streams

MARYLAND DEPARTMENT OF NATURAL RESOURCES

MARYLAND
DEPARTMENT OF
NATURAL RESOURCES

AQUATIC WORM

Tolerant

MARYLAND
DEPARTMENT OF
NATURAL RESOURCES

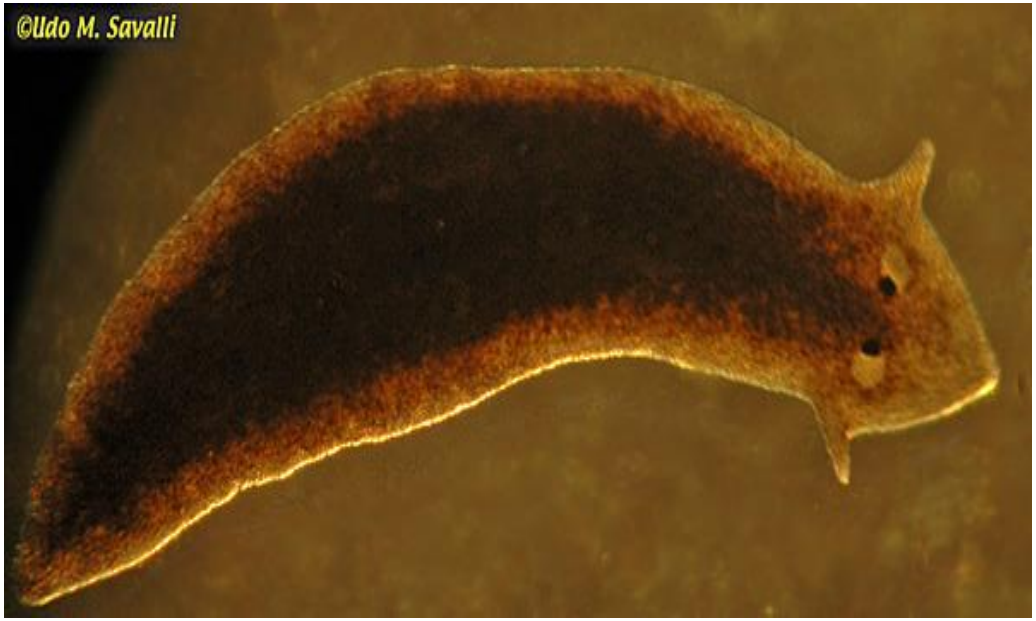
Non-biting midge vs. Aquatic worm

L

MARYLAND
DEPARTMENT OF
NATURAL RESOURCES

Planaria

Somewhat Tolerant



Explore and Restore Maryland Streams

For more information about the Explore and Restore Maryland Streams professional development workshops for educators contact:

Jen Wolfe
Maryland Department of Natural Resources
Environmental Education Specialist, Conservation Education and Stewardship Center
Explore and Restore Maryland Streams
jennifer.wolfe1@maryland.gov

For more information about the Maryland Biological Stream Survey and content in this PowerPoint contact:

Dan Boward
Maryland Department of Natural Resources
Natural Resources Biologist VI, Resource Assessment Service
dan.boward@maryland.gov

Sara Weglein
Maryland Department of Natural Resources
Natural Resources Technician IV, Resource Assessment Service
sara.weglein@maryland.gov