The Basics of Biological Monitoring and Assessment

Howard County Watershed Stewards Academy
April 16, 2019

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…and 28-year Columbia resident!

Purpose of presentation

- Why is biology important to monitor?
- Describe components of biological monitoring program
- How biology can be used to set watershed/ecosystem management goals

Why is biology important?

- Aquatic organisms live in streams, rivers, wetland, lakes, ponds, estuaries
- If the community of aquatic organisms in a waterbody is in good condition, the waterbody is healthy
  - Little to no pollution (stressors)
- Biological integrity is part of the Clean Water Act

Stressors sources

Stressors

Response indicators

Healthy streams

Good physical habitat, but water chemistry (?)

Unstable channels

Headcuts

Concrete channels – stable but not healthy

Land cover alteration

Stressors sources

↓

Stressors

↓

Response indicators

There are many potential stressors

- Metals
- Sediments
- Nutrients
- Ionic strength
- Low dissolved oxygen
- Temperature
- Non-native species
- Flow alteration (increased flashiness)
- Flow alteration (dam)
- Unspecified toxic chemicals
- Degraded physical habitat

Response indicators

- Most widely used in North America, for freshwater ecosystems
  - Benthic macroinvertebrates
  - Fish
  - Periphyton (mostly diatoms)
  - Zooplankton/phytoplankton
- For estuaries
  - Macrobenthos
  - Aquatic vegetation: submerged, emergent, floating
  - Chlorophyll *a*
  - Fish

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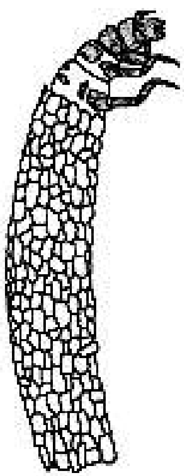
Sampling benthic macroinvertebrates (aquatic insects, snails, crustaceans)

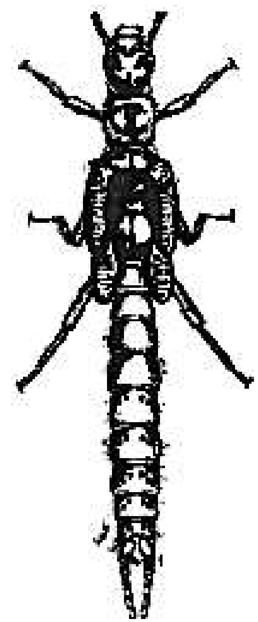
Benthic samples – laboratory processed

Shredders: Examples

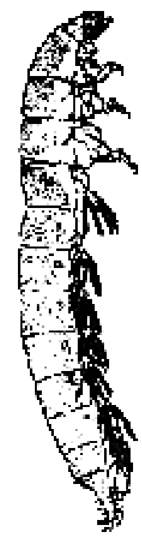


Limnephilidae:
Hesperophylax

Limnephilidae:
Pseudostenophylax



Capniidae:
Eucanopsis

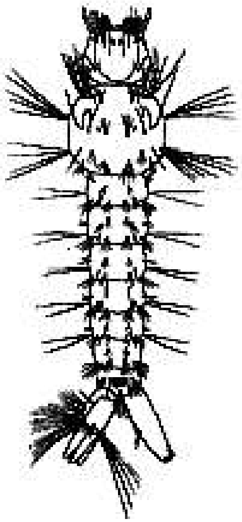


Ptilodactylidae:
Stenocolus

Collector-Filterers: Examples

Trichoptera: Hydropsychidae

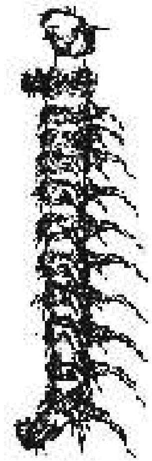
Diptera: Simuliidae



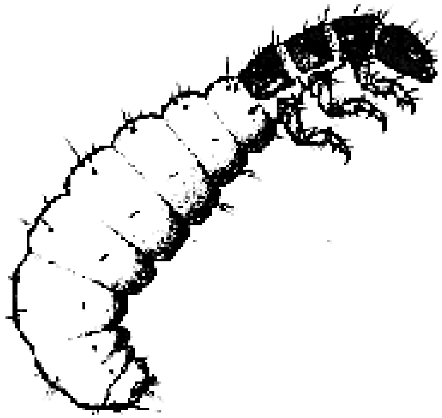
Culicidae: *Anopheles*

Collector-Gatherers: Examples

Elmidae: *Ancyronyx*

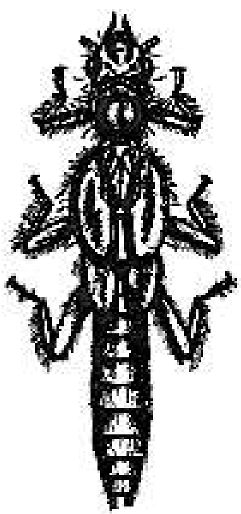


Ceratopogonidae: *Atrichopogon*

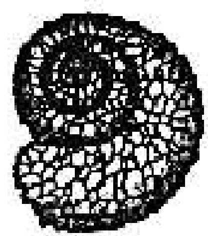


Hydroptilidae: *Ochrotrichia*

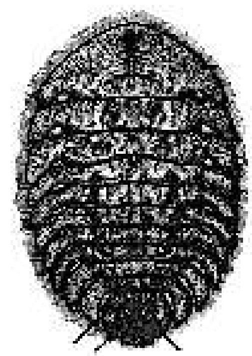
Grazers and Scrapers: Examples



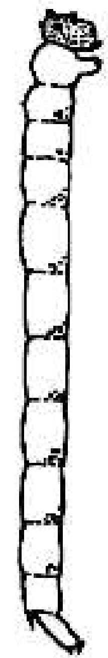
Chloroperlidae: *Haploperla*



Helicopsychidae: *Helicopsyche*

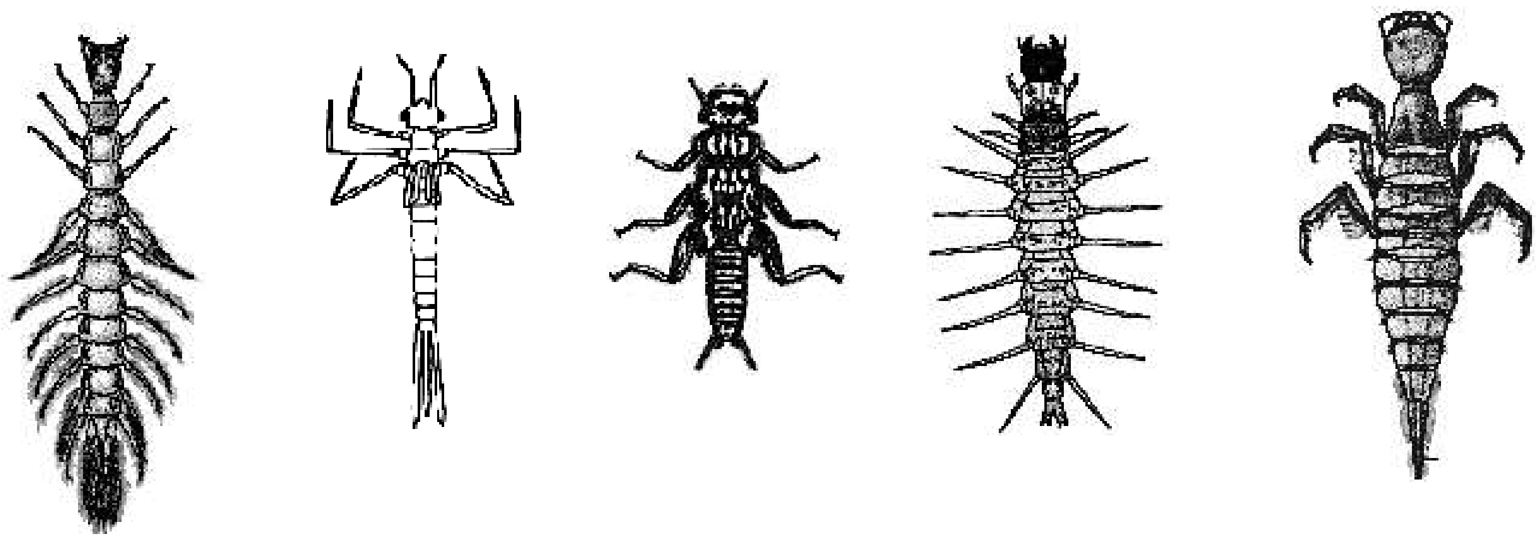


Psephenidae: *Ectopria*



Thaumaleidae: *Thaumalea*

Predators: Examples



Gyrinidae: *Dineutus*

Calopterygidae: *Calopteryx*

Perlidae: *Eccoptura*

Corydalidae: *Neohermes*

Dytiscidae: *Cybister*

Sampling fish

Mudminnow

Redfin pickerel

Pumpkinseed

Rock bass

Rosyside dace

Satinfin shiner

American eel

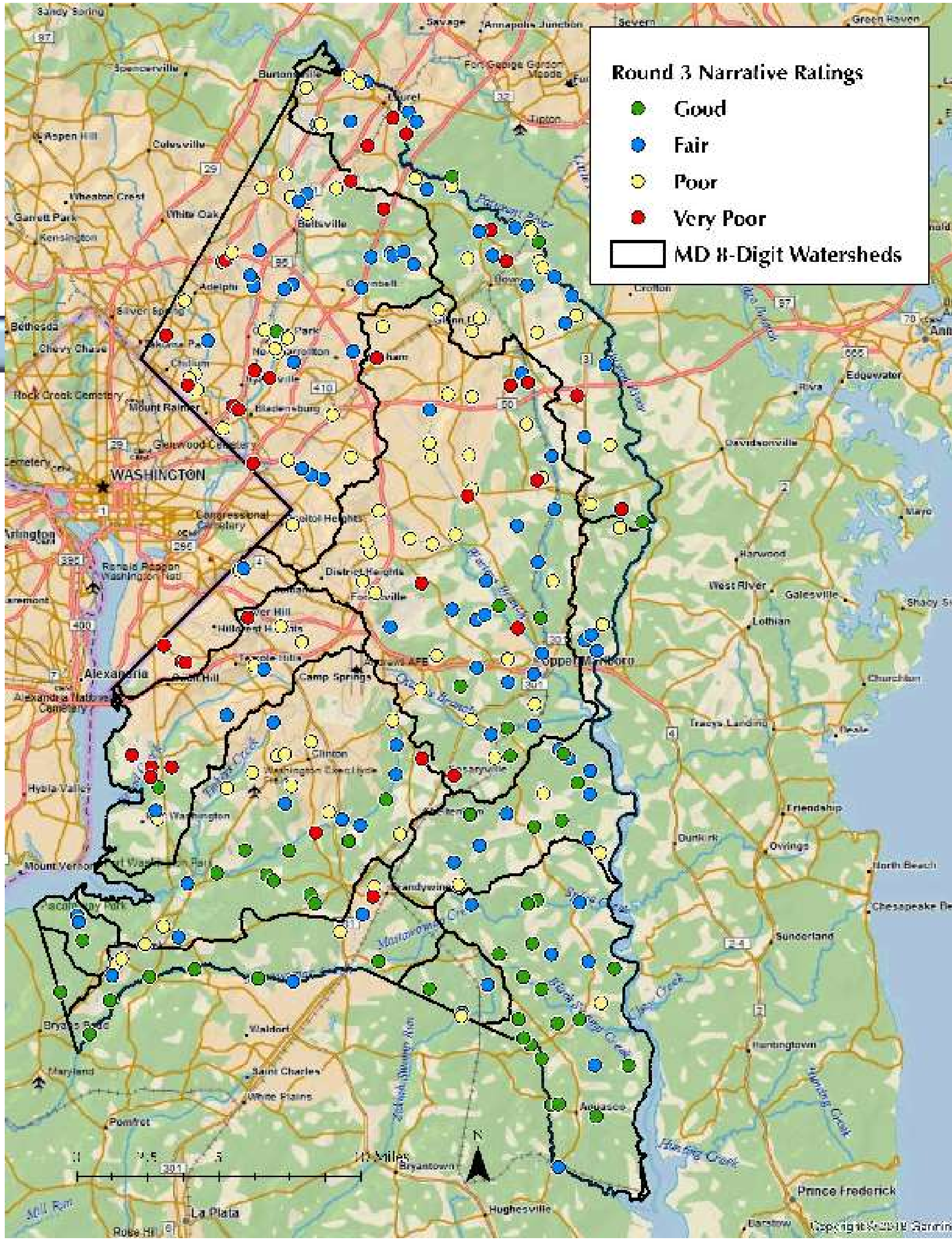
Steps in bioassessment

- Step 1 - Site selection
- Step 2 - Field sampling (biology, physical habitat, water chemistry)
- Step 3 - Taxonomic identification
- Step 4 - Index calculation and scoring
- Step 5 - Site assessment
- Step 6 - Watershed assessment

Data quality documentation

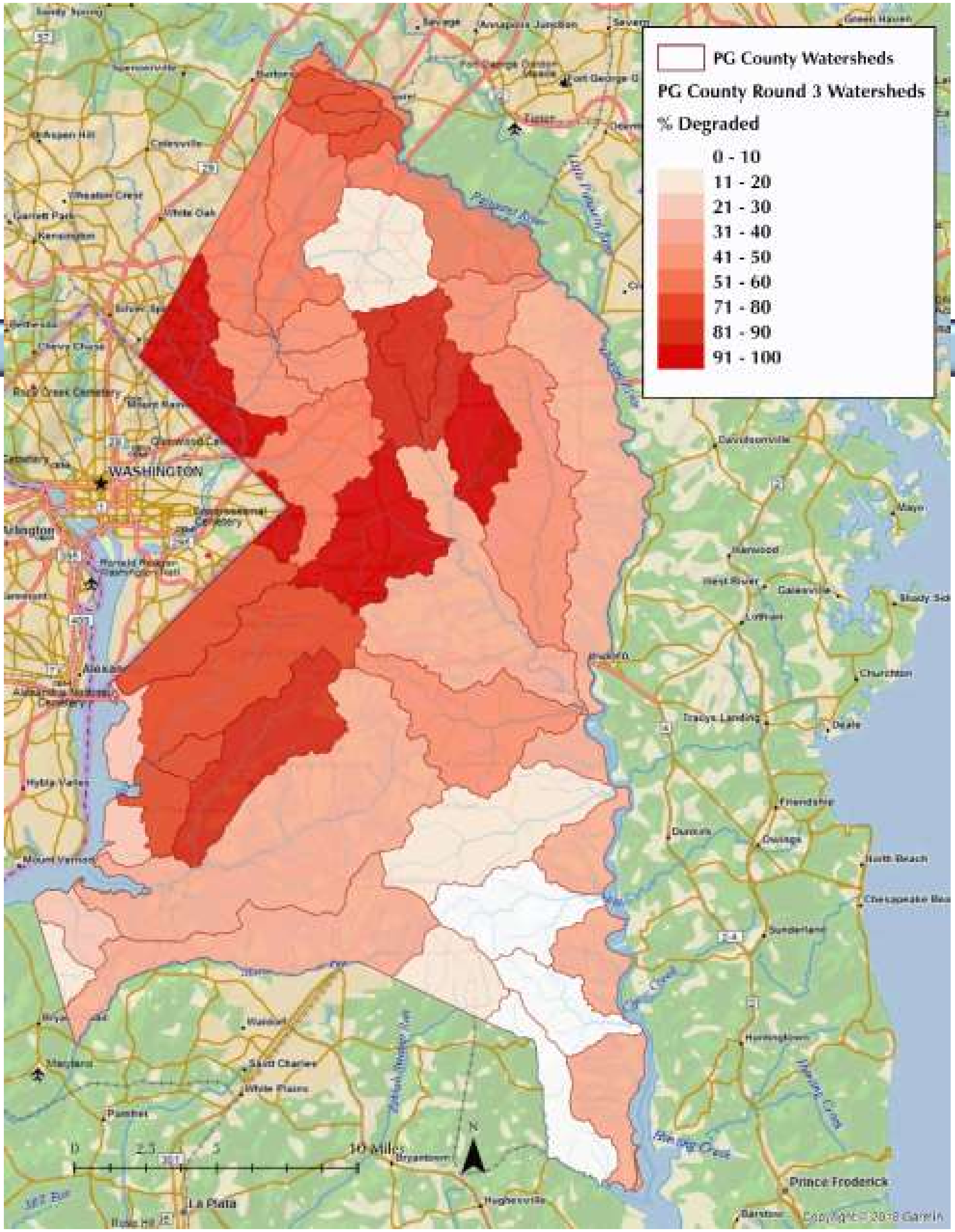
Sorting/subsampling bias	n	median			MQO target
Percent sorting efficiency (PSE)	46	92			>90
Taxonomic precision					
Percent difference in enumeration (PDE)	13	0.7			<5
Percent taxonomic disagreement (PTD)	13	7.6			<15
Field sampling precision		Scoring range	CI90	CV	
Physical habitat	15	0-200	14.2	6.5	
Biological index (MMI 45a)	14	0-100	6.7	8.6	

Round 3, monitoring and assessment (2015-2017)



Point assessments
(site-specific)

Round 3, monitoring and assessment (2015-2017)



Subwatershed-scale biological assessments

Biologically-degraded stream miles

(rated as either "poor" or "very poor")

	Total	Degraded	Percent
County	951.2	469.4	49.3
Anacostia	163.6	115.8	70.8
Patuxent	504.1	223.8	44.4
Potomac	283.5	129.8	45.8

Anacostia basin

Subwatershed name	Degraded percent
Upper Northeast Branch	33.3%
Paint Branch	37.5%
Indian Creek	58.3%
Upper Beaverdam Creek	62.5%
Lower Northeast Branch	75.0%
Lower Beaverdam Creek	91.7%
Northwest Branch	100.0%
Sligo Creek	100.0%
Brier Ditch	100.0%
Upper Anacostia River	100.0%
Lower Anacostia River	100.0%

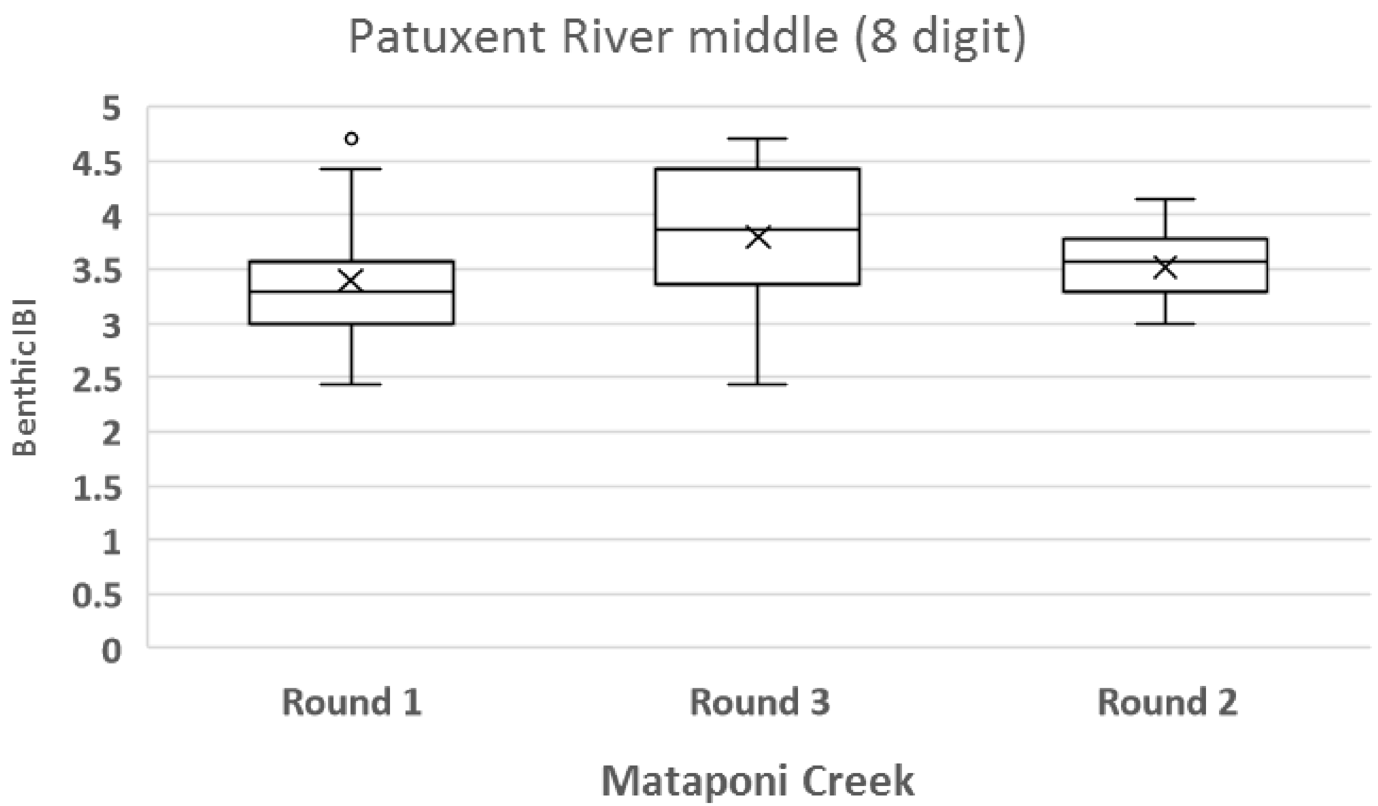
Patuxent basin

Subwatershed name	Degraded percent
Bear Branch	0.0%
Spice Creek	0.0%
Black Swamp Creek	0.0%
Mataponi Creek	18.2%
Charles Branch	20.0%
Swanson Creek	25.0%
Crows Branch	33.3%
Horsepen Branch	33.3%
Baldhill Branch	33.3%
Western Branch	33.3%
Walker Branch	50.0%
Lower Patuxent River	55.0%
Collington Branch	58.3%
Upper Patuxent River	62.5%
Folly Branch	75.0%
Northeast Branch (Western Branch)	75.0%
Southwest Branch	88.9%
Lottsford Branch	100.0%

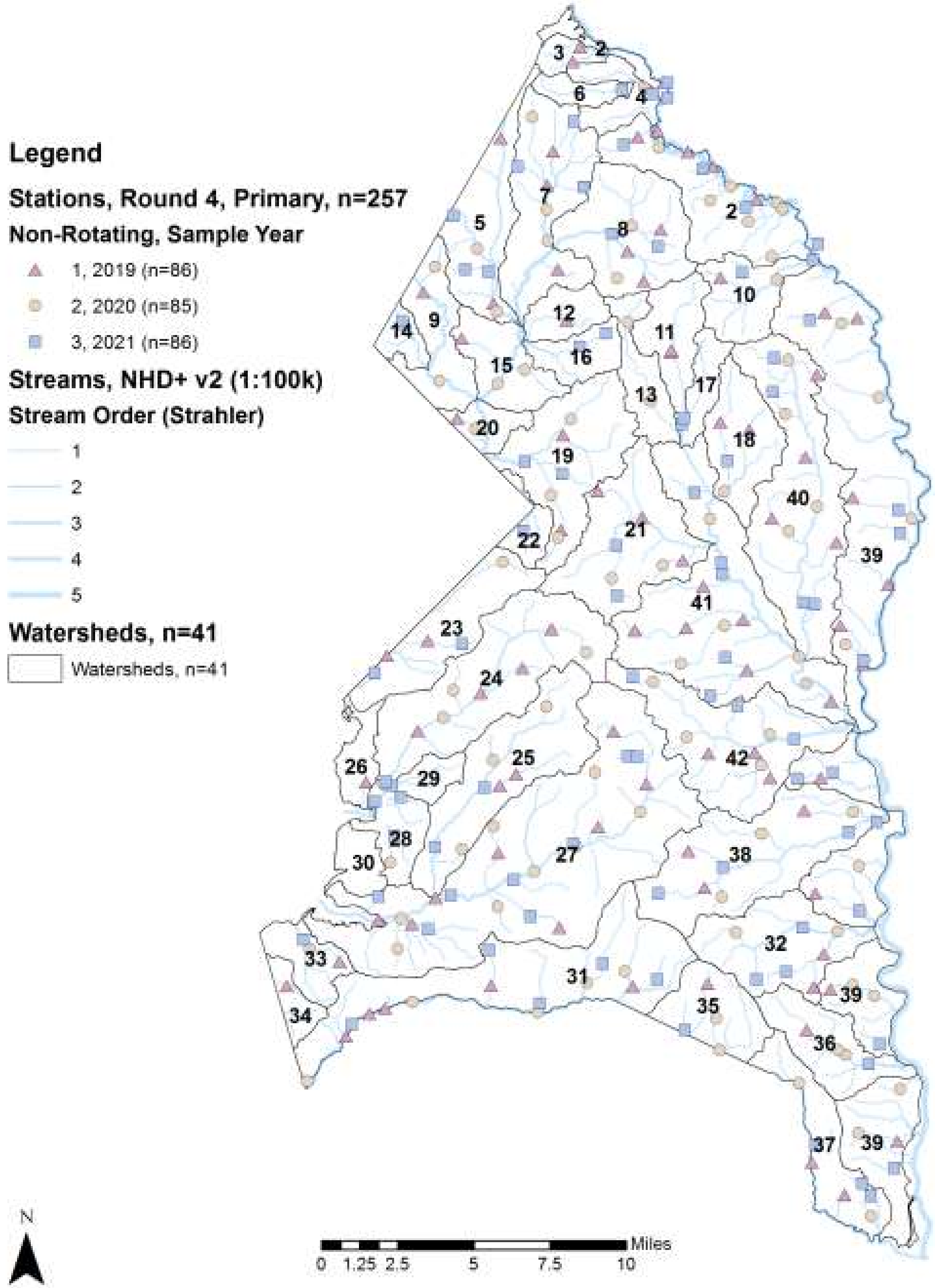
Potomac basin

Subwatershed name	Degraded percent
Pomonkey Creek	0.0%
Piscataway Creek	15.0%
Lower Potomac River	25.0%
Broad Creek	33.3%
Zekia Swamp Creek	33.3%
Mattawoman Creek	46.2%
Tinkers Creek	66.7%
Oxon Run	100.0%
Henson Creek	100.0%
Upper Potomac River	100.0%
Hunters Mill Creek	100.0%
Swan Creek	100.0%

Mataponi Creek



Round 4, monitoring and assessment, sample locations



3 year non-rotating basin 2019-2021

Setting watershed management goals (longer-term)

- By comparing assessment rounds, changes in the proportion of biologically-degraded stream channel miles will show what watershed management activities in the county have accomplished in 11 years
- Potential goal (example): By 2025, the proportion of biologically-degraded stream miles in the county will be reduced from 49.3% to 25%

How do efforts of HoCo WSA stewards fit in to this?

- Stream biota don't care whether their home/habitat is on public property or private property
- Environmental/stormwater regulations are good for stressor control on **public property**
- Stewards contribute to stressor control on **private property**
- Stressors are cumulative from all sources
- Biological monitoring and assessment provides defensible indicator of overall effectiveness of stressor control

Questions?