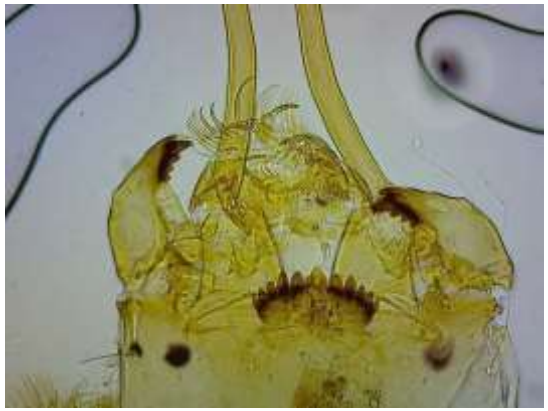
# Interpreting Macroinvertebrate Data: A New Perspective



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Jason York

# Different Sweeps for Different Peeps

- **North Carolina:** Full Scale and Qual 4. Field picking.
- **Maryland:** 20 Jabs proportional to available habitat. Laboratory sub-sampling.
- **Virginia:** Single Habitat. Laboratory sub-sampling. Macroinvertebrate monitoring required for stream restoration projects.
- **Tennessee:** Semi-Quantitative Single Habitat Sample (SQSH) determined by ecoregion. Macroinvertebrate monitoring as part of the Stream Quantification Tool (SQT) as a proxy for physicochemical data.
- **South Carolina:** Timed- Qualitative Multiple Habitat Sampling Protocol (MHSP)

- Name that Trait or Habit

Clinger

Burrower

Swimmer

Predator

- Name that trait or habit continued…

Shredder

Grazer

T-Rex

Scraper

Filter feeder

# EPA Metrics

- **Table 7-1. Definitions of best candidate benthic metrics and predicted direction of metric response to increasing perturbation (compiled from DeShon 1995, Barbour et al. 1996b, Fore et al. 1996, Smith and Voshell 1997).**

| Category | Metric | Definition | Predicted response to increasing perturbation |
|---|---|---|---|
| **Richness measures** | Total No. taxa | Measures the overall variety of the macroinvertebrate assemblage | Decrease |
| | No. EPT taxa | Number of taxa in the insect orders Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) | Decrease |
| | No. Ephemeroptera Taxa | Number of mayfly taxa (usually genus or species level) | Decrease |
| | No. Plecoptera Taxa | Number of stonefly taxa (usually genus of species level) | Decrease |
| | No. Trichoptera Taxa | Number of caddisfly taxa (usually genus or species level) | Decrease |
| **Composition measures** | % EPT | Percent of the composite of mayfly, stonefly, and caddisfly larvae | Decrease |
| | % Ephemeroptera | Percent of mayfly nymphs | Decrease |
| **Tolerance/Intolerance measures** | No. of Intolerant Taxa | Taxa richness of those organisms considered to be sensitive to perturbation | Decrease |
| | % Tolerant Organisms | Percent of macrobenthos considered to be tolerant of various types of perturbation | Increase |
| | % Dominant Taxon | Measures the dominance of the single most abundant taxon. Can be calculated as dominant 2, 3, 4, or 5 taxa. | Increase |
| **Feeding measures** | % Filterers | Percent of the macrobenthos that filter FPOM from either the water column or sediment | Variable |
| | % Grazers and Scrapers | Percent of the macrobenthos that scrape or graze upon periphyton | Decrease |
| **Habit measures** | Number of Clinger Taxa | Number of taxa of insects | Decrease |
| | % Clingers | Percent of insects having fixed retreats or adaptations for attachment to surfaces in flowing water. | Decrease |

# Other Potential Metrics:

- **Table 7-2. Definitions of additional potential benthic metrics and predicted direction of metric response to increasing perturbation.**

| Category | Metric | Definition | Predicted response to increasing perturbation | References |
|---|---|---|---|---|
| **Richness measures** | No. *Pteronarcys* species | The presence or absence of a long-lived stonefly genus (2-3 year life cycle) | Decrease | Fore et al. 1996 |
| | No. Diptera taxa | Number of "true" fly taxa, which includes midges | Decrease | DeShon 1995 |
| | No. Chironomidae taxa | Number of taxa of chironomid (midge) larvae | Decrease | Hayslip 1993, Barbour et al. 1996b |
| **Composition measures** | % Plecoptera | Percent of stonefly nymphs | Decrease | Barbour et al. 1994 |
| | % Trichoptera | Percent of caddisfly larvae | Decrease | DeShon 1995 |
| | % Diptera | Percent of all "true" fly larvae | Increase | Barbour et al. 1996b |
| | % Chironomidae | Percent of midge larvae | Increase | Barbour et al. 1994 |
| | % Tribe Tanytarsini | Percent of Tanytarisinid midges to total fauna | Decrease | DeShon 1995 |
| | % Other Diptera and noninsects | Composite of those organisms generally considered to be tolerant to a wide range of environmental conditions | Increase | DeShon 1995 |
| | % *Corbicula* | Percent of asiatic clam in the benthic assemblage | Increase | Kerans and Karr 1994 |
| | % Oligochaeta | Percent of aquatic worms | Variable | Kerans and Karr 1994 |
| **Tolerance/Intolerance measures** | No. Intol. Snail and Mussel species | Number of species of molluscs generally thought to be pollution intolerant | Decrease | Kerans and Karr 1994 |
| | % Sediment Tolerant organisms | Percent of infaunal macrobenthos tolerant of perturbation | Increase | Fore et al. 1996 |
| | Hilsenhoff Biotic Index | Uses tolerance values to weight abundance in an estimate of overall pollution. Originally designed to evaluate organic pollution | Increase | Barbour et al. 1992, Hayslip 1993, Kerans and Karr 1994 |
| | Florida Index | Weighted sum of intolerant taxa, which are classed as 1 (least tolerant) or 2 (intolerant). Florida Index = 2 X Class 1 taxa + Class 2 taxa | Decrease | Barbour et al. 1996b |
| | % Hydropsychidae to Trichoptera | Relative abundance of pollution tolerant caddisflies (metric could also be regarded as a composition measure) | Increase | Barbour et al. 1992, Hayslip 1993 |
| **Feeding measures** | % Omnivores and Scavengers | Percent of generalists in feeding strategies | Increase | Kerans and Karr 1994 |
| | % Ind. Gatherers and Filterers | Percent of collector feeders of CPOM and FPOM | Variable | Kerans and Karr 1994 |
| | % Gatherers | Percent of the macrobenthos that "gather" | Variable | Barbour et al. 1996b |
| | % Predators | Percent of the predator functional feeding group. Can be made restrictive to exclude omnivores | Variable | Kerans and Karr 1994 |
| | % Shredders | Percent of the macrobenthos that "shreds" leaf litter | Decrease | Barbour et al. 1992, Hayslip 1993 |
| **Life cycle measures** | % Multivoltine | Percent of organisms having short (several per year) life cycle | Increase | Barbour et al. 1994 |
| | % Univoltine | Percent of organisms relatively long-lived (life cycles of 1 or more years) | Decrease | Barbour et al. 1994 |

# The River Continuum Concept

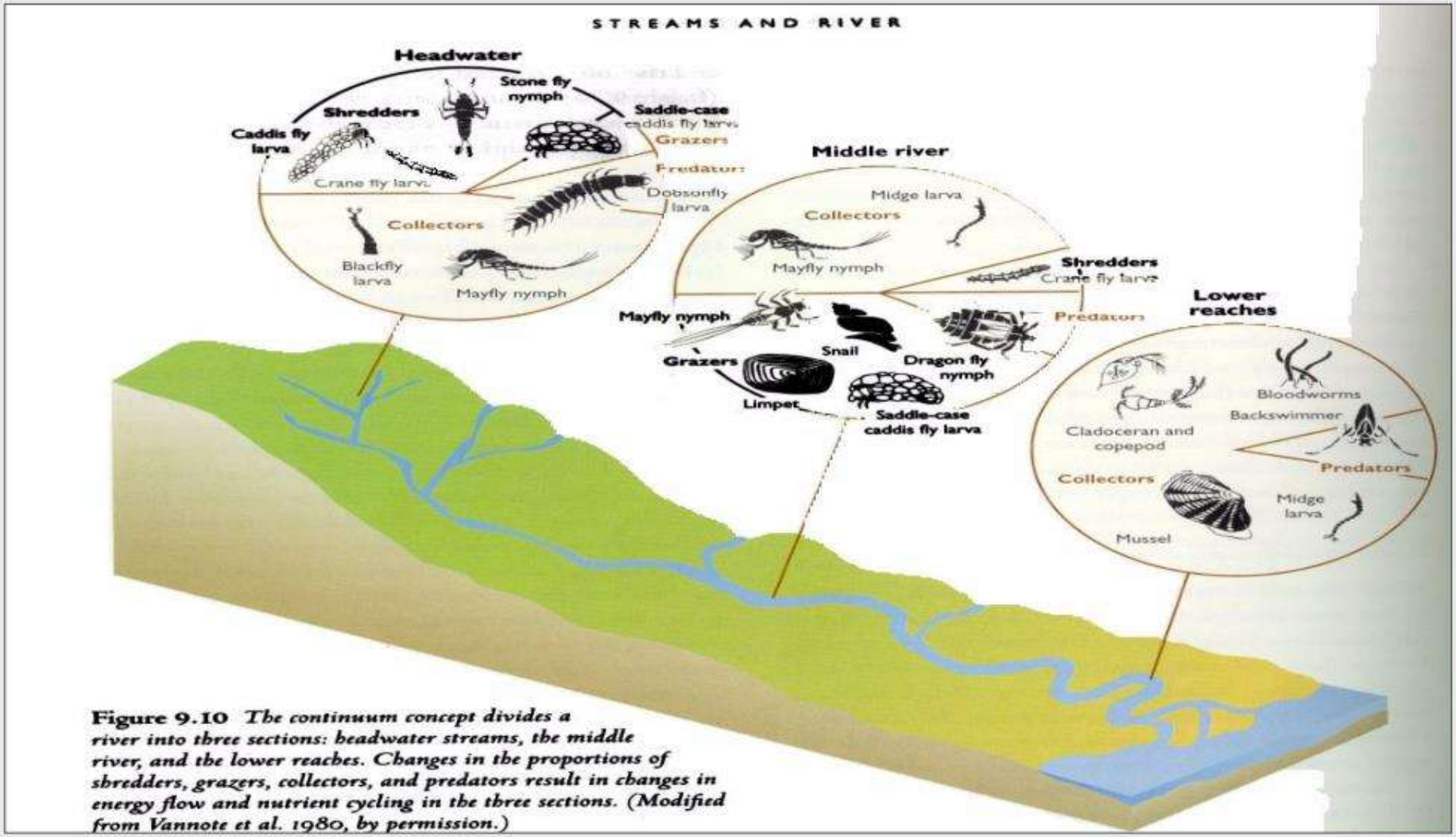


**Figure 9.10** *The continuum concept divides a river into three sections: headwater streams, the middle river, and the lower reaches. Changes in the proportions of shredders, grazers, collectors, and predators result in changes in energy flow and nutrient cycling in the three sections. (Modified from Vannote et al. 1980, by permission.)*

# Southeastern/Mid-Atlantic Macroinvertebrate Metrics

**North Carolina** (Lowest Practical Taxonomic Level): North Carolina Biotic Index, Taxa Richness, EPT Taxa Richness, Sensitive Taxa – Tolerance Value ≤ 2.5 (or other predetermined value), Bioclassification – Excellent, Good, Good-Fair, Fair, Poor

**South Carolina**: Biotic Index, EPT index – if sample size is < 100 organisms, Bioclassification – Excellent, Good, Good-Fair, Fair, Poor

**Virginia**: Virginia Stream Conditions Index – Non-coastal Streams: Taxa Richness, Taxonomic composition, Functional Feeding Group, Habitat, Degree of Tolerance, Tolerance Value

**Tennessee** (Genus Level ID): Tennessee Macroinvertebrate Index (TMI):Taxa Richness, EPT Richness, % EPT – Cheum, % OC, NCBI, % Clinger – Cheum, % Tnutol = ((Total number of Cheumatopsyche, Stenelmis, Polypedilum, Cricotopus, Cricotopus/Orthocladius, Lirceus, Caenis, Gastropoda, Oligochaeta) / Total N) * 100

**Georgia:** Coastal plain headwater stream restoration index (CP-HStR): Genus taxa richness, Proportion genus EPT taxa richness, Proportion genus collector-filterer taxa richness, Proportion genus clinger taxa richness, Proportion genus swimmer taxa richness, Proportion genus shredder taxa richness (Somerville & Pond, 2022).

**Maryland** (Genus Level ID): Benthic Index of Biotic Integrity (BIBI), chironomid counts

from *Evan, R.R., A. Seager, G.C.L. David. 2021. Overview of benthic macroinvertebrates in freshwater streams. U.S. Army Engineer Research and Development Center, Cold Regions Research and Engineering Laboratory, Hanover, New Hampshire. White Pater, 64 pages.*

In general, there are a few metrics that are standard between most state water quality monitoring programs, which are based on the concept of indicator organisms:

- % EPT (percentage of Ephemeroptera, Plecoptera, and Trichoptera taxa, or mayfly nymphs, stonefly nymphs, and caddisfly larvae)
    - % EPT is total number of EPT individuals in a sample divided by the total number of all macroinvertebrates found in the sample, then multiplied by 100 to get the percentage. The higher the percentage the better the water quality, for example
- % Ephemeroptera (percentage of mayfly nymphs)
- % Chironomidae (percentage of chironomid midge larvae (Diptera))
- % Clingers (percentage of benthic macroinvertebrates considered to use a clinging habit: see Section 3.1)

# Observed Vs Expected Ratios: Pre-Construction and Reference Reach Data

| Site Data | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Collection Date | Total #I | NCBI (Semi-Quantitative) | Taxa Richness | EPT Richness | %Intol | %CN - Cheum | %EPT - Cheum | %OC | %Tnutol |
| R1 Upstream | 5/6/2021 | 69 | 4.41 | 14 | 8 | 17.39 | 34.78 | 59.42 | 23.19 | 14.49 |
| R1 Downstream | 5/6/2021 | 68 | 4.61 | 22 | 11 | 17.65 | 41.18 | 50 | 26.47 | 17.65 |
| UT3 | 5/6/2021 | 72 | 3.56 | 21 | 10 | 34.72 | 36.11 | 56.94 | 8.33 | 5.56 |
| Reference Reach | 6/8/2021 | 174 | 4.00 | 28 | 18 | 18.97 | 51.15 | 63.22 | 5.75 | 14.94 |
| | | | | | | | | | | |
| Observed / Expected Ratios | | | | | | | | | | |
| | Total #I | NCBI (Semi-Quantitative) | Taxa Richness | EPT Richness | %Intol | %CN - Cheum | %EPT - Cheum | %OC | %Tnutol | |
| R1 Upstream | 0.40 | 1.10 | 0.50 | 0.44 | 0.92 | 0.68 | 0.94 | 4.03 | 0.97 | |
| R1 Downstream | 0.39 | 1.15 | 0.79 | 0.61 | 0.93 | 0.81 | 0.79 | 4.60 | 1.18 | |
| UT3 | 0.41 | 0.89 | 0.75 | 0.56 | 1.83 | 0.71 | 0.90 | 1.45 | 0.37 | |
| Reference Reach | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |
| Site O/E Means | 0.40 | 1.05 | 0.68 | 0.54 | 1.23 | 0.73 | 0.88 | 3.36 | 0.84 | |
| | | | | | | | | | | |

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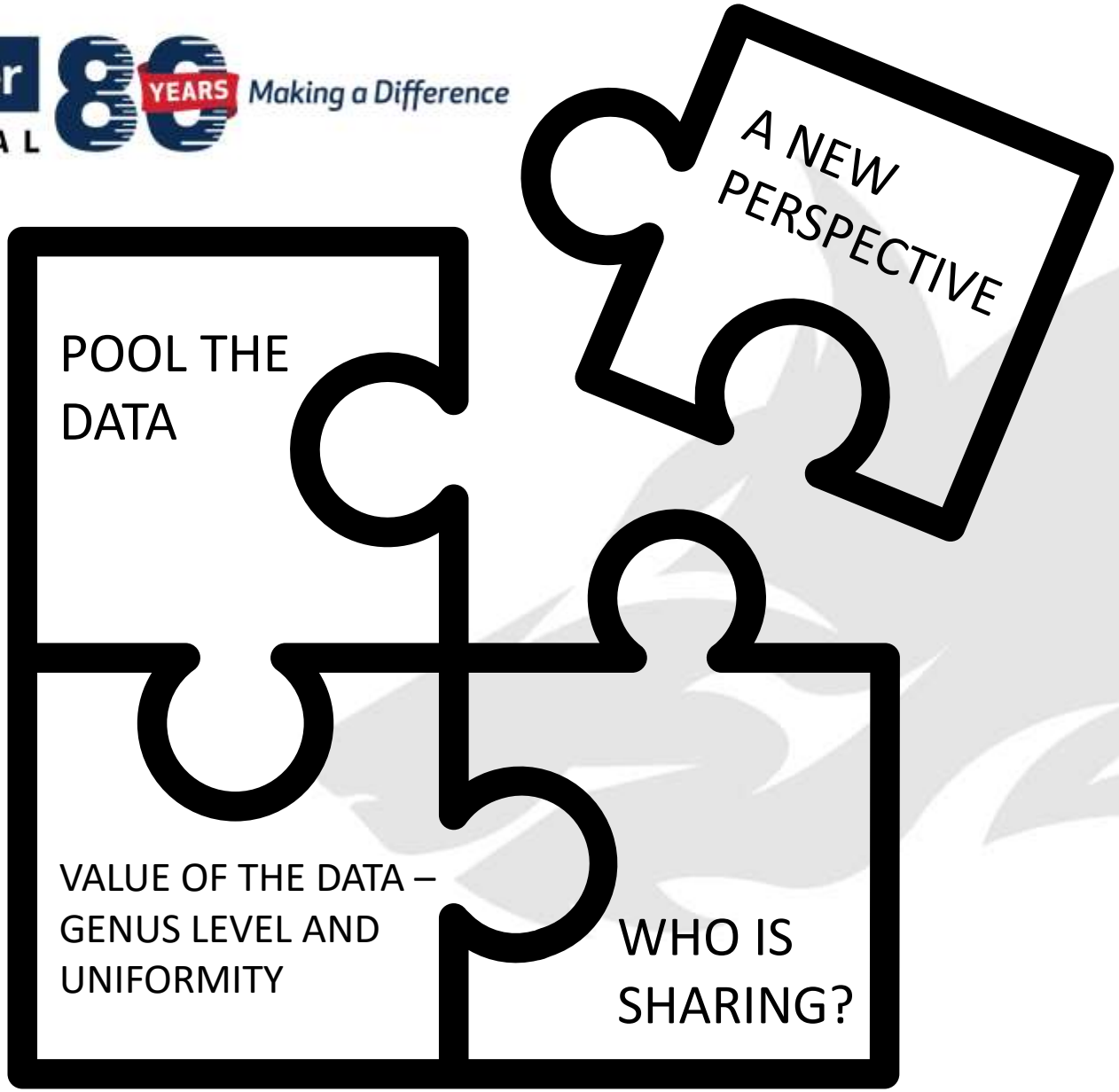

Import...

Latitude

0

Use Semi-Quantitative NCB

Family

# Individuals

1

# Benthic Macroinvertebrate Reporting Tool

## Version 0.9.1

This is the initial release of the Benthic Macroinvertebrate Reporting Tool. This application is designed to streamline assembly and reporting of benthic macroinvertebrate data and demonstrate the opportunity to further customize and extend benthic data reporting.

## Features

- Easily generate robust field reports.

- Automatically match input data to relevant information within North Carolina and/or Tennessee SOP for Collection and Analysis of Benthic Macroinvertebrates.

- Automatically calculate site summary statistics including, but not limited to: NC biotic index, taxa richness, percent Oligochaeta/Chironomid, and percent intolerant.

- Generate visualizations based on entered field survey data.

- Export raw and summary data products as spreadsheets (Excel) or graphs (png) to easily transfer work to other platforms.

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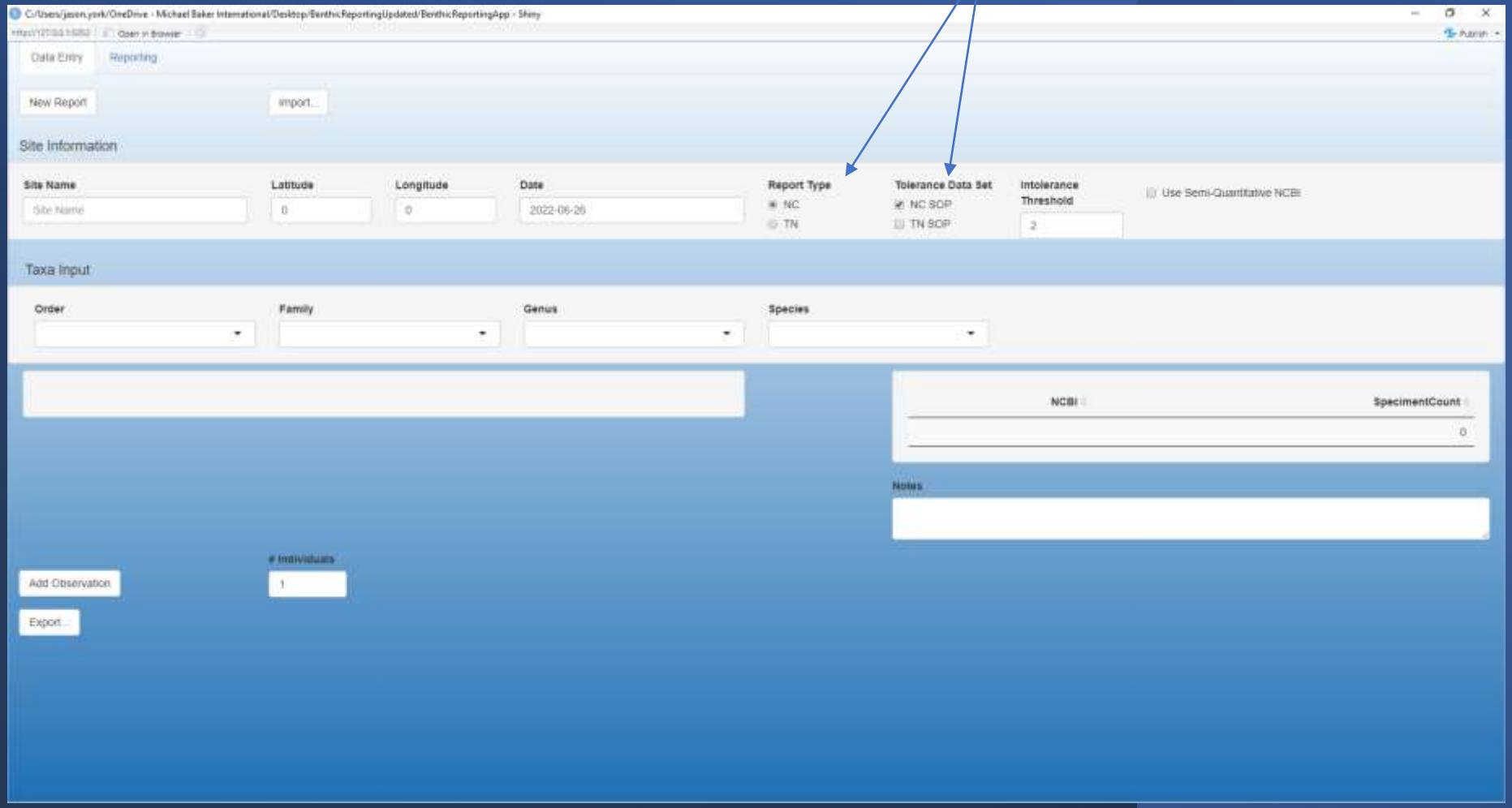
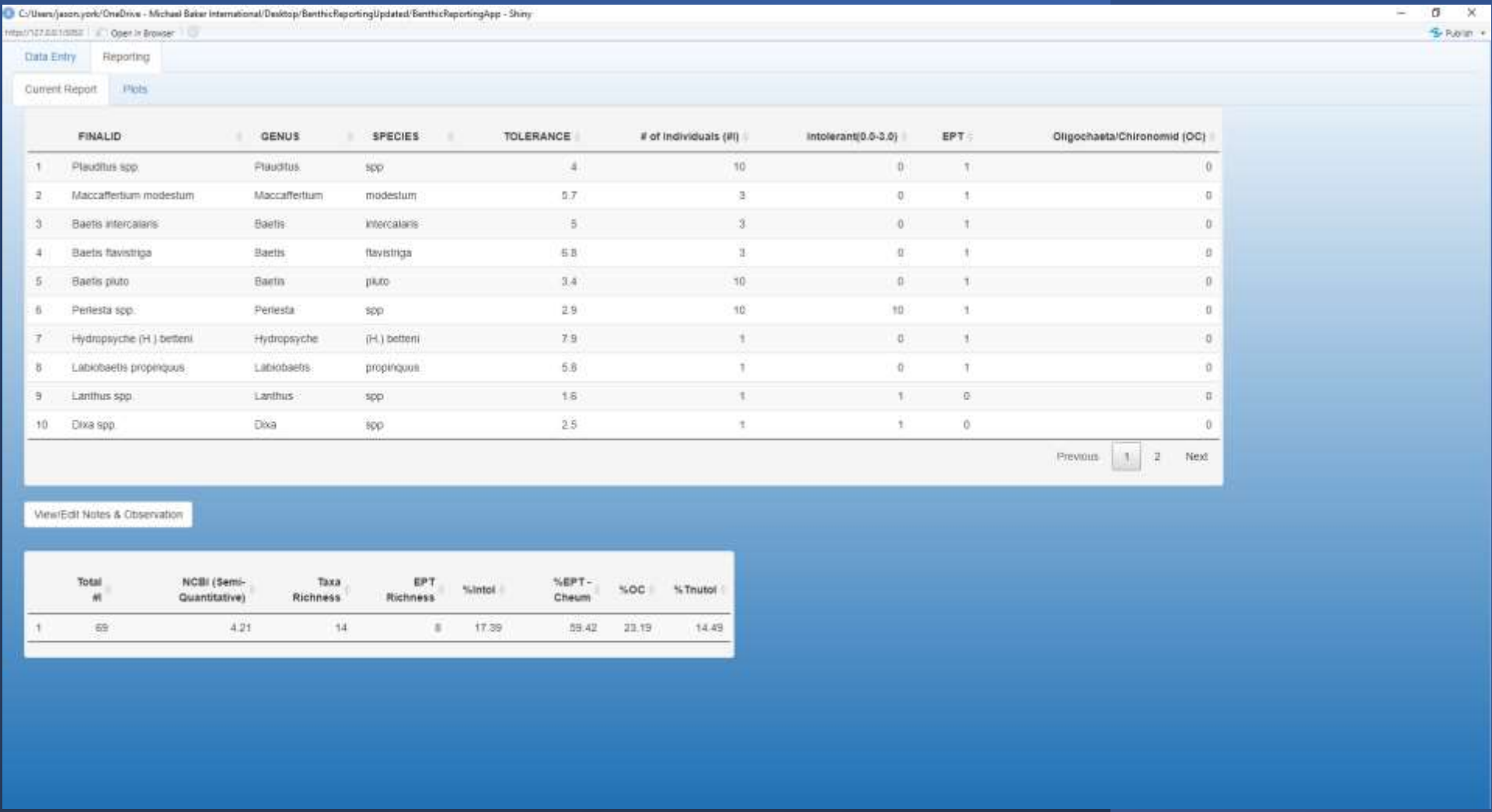
Knowledge Data Values KDV Decision Analysis LLC

# Add more states

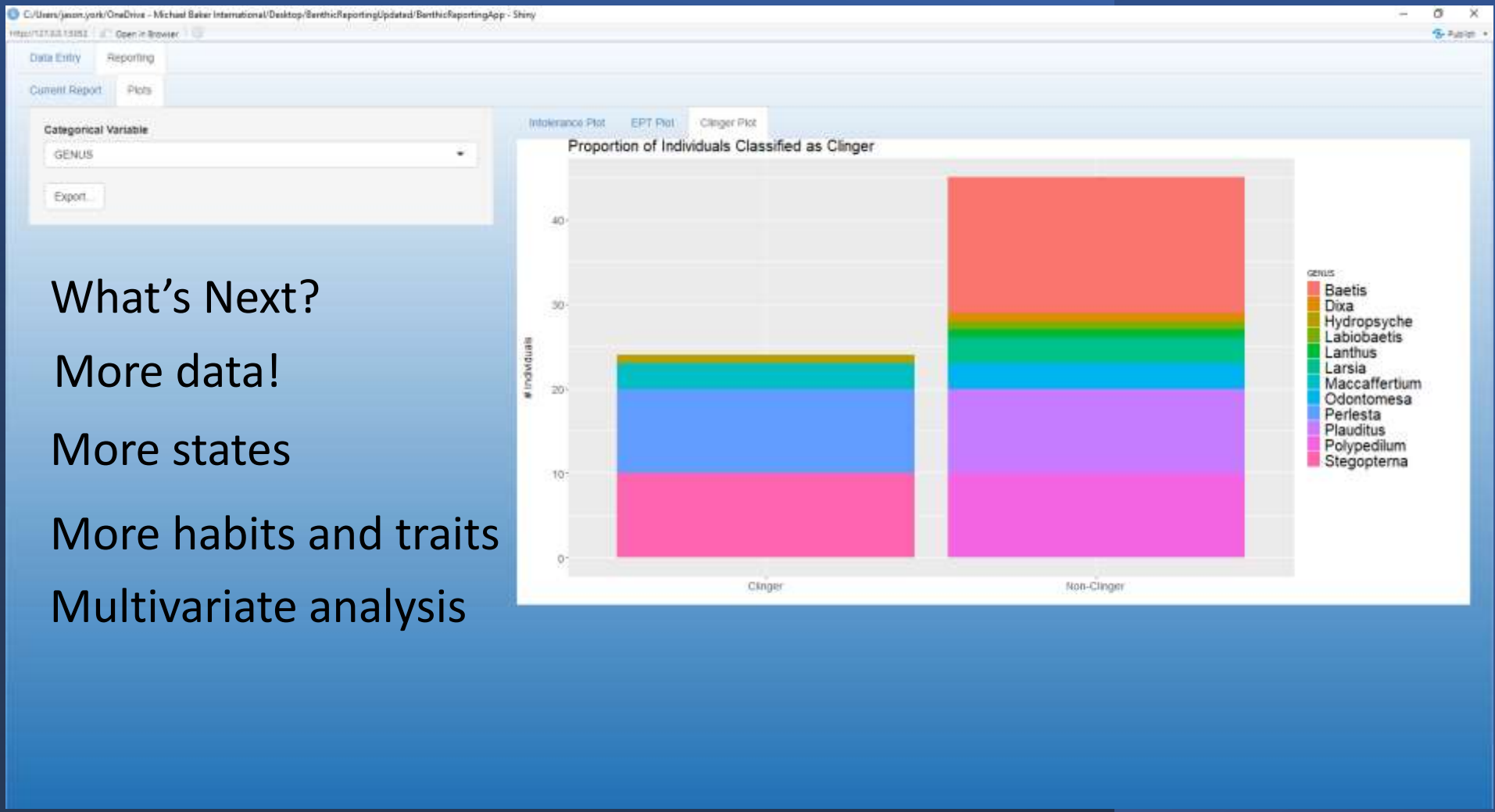





| | FINALID | GENUS | SPECIES | TOLERANCE | # of Individuals (#I) | Intolerant(0.0-3.0) | EPT | Oligochaeta/Chironomid (OC) |
|---|---|---|---|---|---|---|---|---|
| 1 | Plaudtus spp | Plaudtus | spp | 4 | 10 | 0 | 1 | 0 |
| 2 | Maccaffertium modestum | Maccaffertium | modestum | 5.7 | 3 | 0 | 1 | 0 |
| 3 | Baetis intercalaris | Baetis | intercalaris | 5 | 3 | 0 | 1 | 0 |
| 4 | Baetis flavistriga | Baetis | flavistriga | 5.8 | 3 | 0 | 1 | 0 |
| 5 | Baetis pluto | Baetis | pluto | 3.4 | 10 | 0 | 1 | 0 |
| 6 | Perlesta spp | Perlesta | spp | 2.9 | 10 | 10 | 1 | 0 |
| 7 | Hydropsyche (H.) betteni | Hydropsyche | (H.) betteni | 7.9 | 1 | 0 | 1 | 0 |
| 8 | Labiobaetis propinquus | Labiobaetis | propinquus | 5.8 | 1 | 0 | 1 | 0 |
| 9 | Lanthus spp | Lanthus | spp | 1.6 | 1 | 1 | 0 | 0 |
| 10 | Dixa spp | Dixa | spp | 2.5 | 1 | 1 | 0 | 0 |

Previous 1 2 Next

| | Total #I | NCBI (Semi-Quantitative) | Taxa Richness | EPT Richness | %Intol | %EPT - Cheum | %OC | %Tnutol |
|---|---|---|---|---|---|---|---|---|
| 1 | 69 | 4.21 | 14 | 8 | 17.39 | 59.42 | 23.19 | 14.49 |




What's Next?

More data!

More states

More habits and traits

Multivariate analysis

# AQUATIC INSECT ECOLOGY FOR ENVIRONMENTAL PROFESSIONALS – LEVEL 2

## Michael Baker Intl. and Penrose Environmental

## September 12-15, 2022

# References and Acknowledgments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- ***Somerville, D. Eric, Pond, Gregory J. 2022. The coastal plain headwater stream restoration (CP-HStR) index: a macroinvertebrate index for assessing the biological effectiveness of stream restoration in the Georgia coastal plain, USA. Environmental Monitoring and Assessment (2022) 194:319.*** https://doi.org/10.1007/s10661-022-09987-6