



GADNR/EPD WATERSHED PROTECTION BRANCH

Macroinvertebrate Metric Calculation Guidelines

For the macroinvertebrate biotic indices, Georgia is divided into 23 subcoregions. The tidal sites are also separated into a category, thus giving the state of Georgia twenty-four discrete macroinvertebrate indices. Once you have determined which index to use based on the sample location in the state, an excel spreadsheet has been developed (or will be developed in the future) to calculate the index score which determines the stream ranking, narrative description, and stream health rating of each of the sampling locations.

To calculate the index, fill in the information on the metric calculation sheets (*i.e.* HBI, %Tolerant taxa, %Predator, EPT taxa, Simpson's Diversity Index) in the excel file for the subcoregion you are working. On the first metric work sheet, fill in the site name or identification number. A different excel file will need to be completed for each sample location. Fill in the numbers of individuals of a particular family, functional feeding group, habit, etc.; as well as taxa numbers, total number of individuals per site, tolerance values, etc. for each of the metric worksheets. There will be 5 to 8 metric worksheets per each index. Once the data has been filled in for each of the metric worksheets then the metrics will be standardized and all calculations will be tabulated. The results can be found in the ranking classification worksheet. Tolerance values, North Carolina tolerance values (for use with the NCBI metric), functional feeding groups, and habit can be found in the GA EPD Macroinvertebrate Taxa List. (Taxa list is formatted for legal size paper.)

GA EPD will continue to refine and calibrate the macroinvertebrate indices. As more data is collected and analyzed, the metrics will be adjusted.

Explanations of the metric equations are below:

When calculating the metrics, each taxa is counted even if it is possible they could be the same genus or species due to not being able to identify the organisms to a lower taxonomic level. This affects metrics that use taxa numbers. For example Perlodidae, *Isoperla sp.*, and *Isoperla clio* are counted as separate taxa.



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Metric Calculations

Richness Metrics:

Ephemeroptera, Plecoptera, Trichoptera Taxa (EPT Taxa)

EPT Taxa = #of Ephemer. taxa + #of Plecoptera taxa + #of Trichoptera taxa

- The taxonomic level of Order is used to determine if an individual is considered to be Ephemeroptera taxa, Plecoptera taxa, & Trichoptera taxa or not Ephemeroptera taxa, Plecoptera taxa, & Trichoptera taxa.
- The taxonomic level of Order can be found in the GA EPD Macroinvertebrate Taxa List (**This list can be found on the EPD website www.gaepd.gov**).

Plecoptera Taxa

Plecoptera Taxa = # of Plecoptera taxa

- The taxonomic level of Order is used to determine if an individual is considered to be Plecoptera taxa or not Plecoptera taxa.
- The taxonomic level of Order can be found in the GA EPD Macroinvertebrate Taxa List.

Coleoptera Taxa

Coleoptera Taxa = # of Coleoptera taxa

(note – do not count adult and larvae as separate taxa)

- The taxonomic level of Order is used to determine if an individual is considered to be Coleoptera taxa or not Coleoptera taxa.
- The taxonomic level of Order can be found in the GA EPD Macroinvertebrate Taxa List.

Diptera Taxa

Diptera Taxa = # of Diptera taxa

- The taxonomic level of Order is used to determine if an individual is considered to be Diptera taxa or not Diptera taxa.
- The taxonomic level of Order can be found in the GA EPD Macroinvertebrate Taxa List.



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Chironomidae Taxa

Chironomidae Taxa = # of **Chironomidae taxa**

- The taxonomic level of Family is used to determine if an individual is considered to be Chironomidae taxa or not Chironomidae taxa.
- The taxonomic level of Family can be found in the GA EPD Macroinvertebrate Taxa List.

Tanytarsini Taxa

Tanytarsini Taxa = # of **Tanytarsini taxa**

- The taxonomic level of Tribe is used to determine if an individual is considered to be Tanytarsini taxa or not Tanytarsini taxa. Tanytarsini is a tribe in the family of Chironomidae.
- The taxonomic level of Tribe can be found in the GA EPD Macroinvertebrate Taxa List.

Margalef's Index

$$D_m = \frac{(S-1)}{\ln(N)}$$

D_m = Margalef's Index (Diversity)

S = Number of Species in a site

N = Total number of Individuals in a sample

LN = natural log

- Do not count larvae and adult for Coleoptera as separate species.
- Species represent any level of taxonomic identification.

Shannon-Wiener Index (base-e)

Shannon-Wiener (base-e) = $-\sum ((p_i) * \ln(p_i))$

- $p_i = n_i/N$ (relative abundance for each species)
- n_i = number of a species
- N = total number of all species
- LN = natural log (base e)



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Simpson's Diversity Index:

$$D = \frac{\sum n(n-1)}{N(N-1)}$$

n = total number of organisms of a particular species (no matter what level of taxonomic identification)

N = total number of organisms of all species (total # of individuals in sample)

Composition Metrics:

% Ephemeroptera, Plecoptera, Trichoptera (%EPT)

$$\% \text{ EPT} = 100 * \frac{\text{\# of Ephemeroptera} + \text{\# of Plecoptera} + \text{\# of Trichoptera}}{\text{Total Individuals in sample}}$$

- The taxonomic level of Order is used to determine if an individual is considered to be Ephemeroptera taxa, Plecoptera taxa, & Trichoptera taxa or not Ephemeroptera taxa, Plecoptera taxa, & Trichoptera taxa.
- The taxonomic level of Order can be found in the GA EPD Macroinvertebrate Taxa List.

% Amphipoda

$$\% \text{ Amp} = 100 * \frac{\text{\# Individual Amphipods}}{\text{Total Individuals in sample}}$$

- The taxonomic level of Order is used to determine if an individual is considered to be Amphipoda or not Amphipoda.
- The taxonomic level of Order can be found in the GA EPD Macroinvertebrate Taxa List.

% Chironomidae

$$\% \text{ Chir} = 100 * \frac{\text{\# Individual Chironomidae}}{\text{Total Individuals in sample}}$$

- The taxonomic level of Family is used to determine if an individual is considered to be Chironomidae or not Chironomidae.
- The taxonomic level of Family can be found in the GA EPD Macroinvertebrate Taxa List.



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% Coleoptera

$$\% \text{Coleoptera} = 100 * [\# \text{ Individual Coleoptera} / \text{Total Individuals in sample}]$$

- The taxonomic level of Order is used to determine if an individual is considered to be Coleoptera or not Coleoptera.
- The taxonomic level of Order can be found in the GA EPD Macroinvertebrate Taxa List.

% Diptera

$$\% \text{Diptera} = 100 * [\# \text{ Individual Diptera} / \text{Total Individuals in sample}]$$

- The taxonomic level of Order is used to determine if an individual is considered to be Diptera or not Diptera.
- The taxonomic level of Order can be found in the GA EPD Macroinvertebrate Taxa List.

% Gastropoda

$$\% \text{Gastropoda} = 100 * [\# \text{ Individual Gastropoda} / \text{Total Individuals in sample}]$$

- The taxonomic level of Class is used to determine if an individual is considered to be Gastropoda individual or not a Gastropoda individual.
- The taxonomic level of Class can be found in the GA EPD Macroinvertebrate Taxa List.

% Isopoda

$$\% \text{Isopoda} = 100 * [\# \text{ Individual Isopoda} / \text{Total Individuals in sample}]$$

- The taxonomic level of Order is used to determine if an individual is considered to be Isopoda individual or not an Isopoda individual.
- The taxonomic level of Order can be found in the GA EPD Macroinvertebrate Taxa List.



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% Non-Insect

$$\%NonIns = 100 * \left[\frac{\# \text{ Individual Non-Insect}}{\text{Total Individuals in sample}} \right]$$

- The taxonomic level of Class is used to determine if an individual is considered to be an Insect or Non-Insect.
- The taxonomic level of Class can be found in the GA EPD Macroinvertebrate Taxa List.

% Odonata

$$\%Odonata = 100 * \left[\frac{\# \text{ Individual Odonata}}{\text{Total Individuals in sample}} \right]$$

- The taxonomic level of Order is used to determine if an individual is considered to be Odonata or not Odonata.
- The taxonomic level of Order can be found in the GA EPD Macroinvertebrate Taxa List.

% Plecoptera

$$\%Plec = 100 * \left[\frac{\# \text{ Individual Plecoptera}}{\text{Total Individuals in sample}} \right]$$

- The taxonomic level of Order is used to determine if an individual is considered to be Plecoptera or not Plecoptera.
- The taxonomic level of Order can be found in the GA EPD Macroinvertebrate Taxa List.

% Tanytarsini

$$\%Tanytarsini = 100 * \left[\frac{\# \text{ Individual Tanytarsini}}{\text{Total Individuals in sample}} \right]$$

- The taxonomic level of Tribe is used to determine if an individual is considered to be Tanytarsini or not Tanytarsini. Tanytarsini is a tribe in the family of Chironomidae.
- The taxonomic level of Tribe can be found in the GA EPD Macroinvertebrate Taxa List.



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% *Oligochaeta*

$$\% \text{Oligo} = 100 * [\# \text{ Individual Oligochaeta} / \text{ Total Individuals in sample}]$$

- The taxonomic level of Subclass is used to determine if an individual is considered to be Oligochaeta or not Oligochaeta.
- The taxonomic level of Subclass can be found in the GA EPD Macroinvertebrate Taxa List.

% *Trichoptera*

$$\% \text{Tri} = 100 * [\# \text{ Individual Trichoptera} / \text{ Total Individuals in sample}]$$

- The taxonomic level of Order is used to determine if an individual is considered to be Trichoptera or not Trichoptera.
- The taxonomic level of Order can be found in the GA EPD Macroinvertebrate Taxa List.

%(*Orthoclaadiinae* / *Total Chironomidae*)

$$\%(\text{Ortho/TC}) = 100 * \frac{\# \text{ Individual Orthoclaadiinae}}{\text{ Total Chironomidae in sample}}$$

- The taxonomic level of Subfamily is used to determine if an individual is considered to be Orthoclaadiinae or not Orthoclaadiinae.
- The taxonomic level of Family is used to determine if an individual is considered to be Chironomidae or not Chironomidae.
- The taxonomic level of Family and Subfamily can be found in the GA EPD Macroinvertebrate Taxa List.

%(*Tanypodinae* / *Total Chironomidae*)

$$\%(\text{Tany/TC}) = 100 * \frac{\# \text{ Individual Tanypodinae}}{\text{ Total Chironomidae in sample}}$$

- The taxonomic level of Subfamily is used to determine if an individual is considered to be Tanypodinae or not Tanypodinae.
- The taxonomic level of Family is used to determine if an individual is considered to be Chironomidae or not Chironomidae.
- The taxonomic level of Family and Subfamily can be found in the GA EPD Macroinvertebrate Taxa List.



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% (Hydropsychidae / Total Trichoptera)

$$\%(\text{Hydro}/\text{TT}) = 100 * \frac{\# \text{ Individual Hydropsychidae}}{\text{Total Trichoptera}}$$

- The taxonomic level of Family is used to determine if an individual is considered to be Hydropsychidae or not Hydropsychidae.
- The taxonomic level of Order is used to determine if an individual is considered to be Total Trichoptera or not Trichoptera.
- The taxonomic level of Family and Order can be found in the GA EPD Macroinvertebrate Taxa List.

% (Hydropsychidae / Total Ephemeroptera + Plecoptera + Trichoptera)

$$\%(\text{Hydro}/(\text{EPT})) = 100 * \frac{\# \text{ Individual Hydropsychidae}}{(\# \text{ of Epheme.} + \# \text{ of Plecoptera} + \# \text{ of Trichoptera})}$$

- The taxonomic level of Family is used to determine if an individual is considered to be Hydropsychidae or not Hydropsychidae.
- The taxonomic level of Order is used to determine if an individual is considered to be Ephemeroptera taxa, Plecoptera taxa, & Trichoptera taxa or not Ephemeroptera taxa, Plecoptera taxa, & Trichoptera taxa.
- The taxonomic level of Order and Family can be found in the GA EPD Macroinvertebrate Taxa List.

% (Chironomus + Cricotopus / Total Chironomidae)

$$\%(\text{Chiro}+\text{Crico}/\text{TC})= 100 * \frac{(\# \text{ Indiv. Chironomus} + \# \text{ Indiv. Cricotopus})}{\text{Total Chironomidae in sample}}$$

- The taxonomic level of genus is used to determine if an individual is considered to be Chironomus and Cricotopus or not Chironomus and Cricotopus.
- The taxonomic level of Family is used to determine if an individual is considered to be Chironomidae or not Chironomidae.
- The taxonomic level of Family and genus can be found in the GA EPD Macroinvertebrate Taxa List.



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Tolerance/Intolerance Metrics:

Tolerant Taxa

Tolerant Taxa = **# of Tolerant taxa**

- Tolerant Individuals have a tolerance value ≥ 7
- Tolerance scores can be found in the GA EPD Macroinvertebrate Taxa List.

*** Please note it is the number of tolerant taxa not the number of tolerant individuals.** (Do not count adult and larvae for beetles as two separate taxa.)

% Tolerant Individuals

$\%TolInd = 100 * \left[\frac{\# \text{ Tolerant Individuals}}{\text{Total Individuals in sample}} \right]$

- Tolerant Individuals have a tolerance value ≥ 7
- Tolerance scores can be found in the GA EPD Macroinvertebrate Taxa List.

Intolerant Taxa

Intolerant Taxa = **# of Intolerant taxa**

- Intolerant Individuals have tolerance values ≤ 3 .
- Tolerance scores can be found in the GA EPD Macroinvertebrate Taxa List.
- Please note it is the number of tolerant taxa not the number of tolerant individuals. (Do not count adult and larvae for beetles as two separate taxa.)

% Intolerant Individuals

$\%IntolInd = 100 * \left[\frac{\# \text{ Intolerant Individuals}}{\text{Total Individuals in sample}} \right]$

- Intolerant Individuals have a tolerance value ≤ 3 .
- Tolerance values can be found in the GA EPD Macroinvertebrate Taxa List.

% Dominant Individuals

$\% \text{ Dominant Individuals} = 100 * \frac{\# \text{ Individual for Dominant Taxa}}{\text{Total Individuals in sample}}$

- Determine the dominant taxa (max individuals per taxa) in a site.



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Dominant Individuals

Dominant Individuals = # **Individuals in sample for the Dominant taxa**

- Determine the dominant taxa (largest number of individuals per taxa) in a site.

Beck's Index

Beck's Index = **[2*(C1 Taxa)] + (C2 Taxa)**

- C1 Taxa = # of Taxa with Tolerance values ≤ 1 .
- C2 Taxa = # of Taxa with Tolerance values > 1 and ≥ 4 .

Hilsenhoff Biotic Index

$$\text{HBI} = \frac{\sum n_i a_i}{N}$$

N = Number of total organisms

n_i = number of specimens in each taxonomic group

a_i = the pollution tolerance score for that taxonomic group

(Tolerance scores can be found in the GA EPD Macroinvertebrate Taxa List.)

North Carolina Biotic Index

$$\text{NCBI} = \frac{\sum n_i nc_i}{N}$$

N = Number of total organisms

n_i = number of specimens in each taxonomic group

nc_i = the North Carolina pollution tolerance score for that taxonomic group

- To calculate the NCBI only use the individuals that have a North Carolina tolerance value in the GA EPD Macroinvertebrate Taxa List. **Exclude all individuals that do not have a NC tolerance value when calculating this metric.**
- North Carolina tolerance scores can be found in the GA EPD Macroinvertebrate Taxa List under the column heading NCTV.



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Functional Feeding Group Metrics:

% Scrapper

$$\% \text{Scrapper} = 100 * [\# \text{ Individual Scrapper} / \text{Total Individuals in sample}]$$

- Scrapper is a functional feeding group.
- Functional feeding groups can be found in the GA EPD Macroinvertebrate Taxa List.

Scrapper Taxa

$$\text{Scrapper Taxa} = \# \text{ of Scrapper taxa}$$

- The functional feeding group is used to determine if an individual is considered to be a Scrapper taxa or not a Scrapper taxa.
- The functional feeding group can be found in the GA EPD Macroinvertebrate Taxa List.

% Collector

$$\% \text{Coll} = 100 * [\# \text{ Individual Collector} / \text{Total Individuals in sample}]$$

- Collector is a functional feeding group.
- Functional feeding groups can be found in the GA EPD Macroinvertebrate Taxa List.

Collector Taxa

$$\text{Collector Taxa} = \# \text{ of Collector taxa}$$

- The functional feeding group is used to determine if an individual is considered to be a Collector taxa or not a Collector taxa.
- The functional feeding group can be found in the GA EPD Macroinvertebrate Taxa List.



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% Predator

$$\%Pred = 100 * \text{[# Individual Predator / Total Individuals in sample]}$$

- Predator is a functional feeding group.
- Functional feeding groups can be found in the GA EPD Macroinvertebrate Taxa List.

Predator Taxa

$$\text{Predator Taxa} = \text{\# of Predator taxa}$$

- The functional feeding group is used to determine if an individual is considered to be a Predator taxa or not a Predator taxa.
- The functional feeding group can be found in the GA EPD Macroinvertebrate Taxa List.

% Shredder

$$\%Shed = 100 * \text{[# Individual Shredder / Total Individuals in sample]}$$

- Shredder is a functional feeding group.
- Functional feeding groups can be found in the GA EPD Macroinvertebrate Taxa List.

Shredder Taxa

$$\text{Shredder Taxa} = \text{\# of Shredder taxa}$$

- The functional feeding group is used to determine if an individual is considered to be a Shredder taxa or not a Shredder taxa.
- The functional feeding group can be found in the GA EPD Macroinvertebrate Taxa List.

% Filterer

$$\%Filt = 100 * \text{[# Individual Filterer / Total Individuals in sample]}$$

- Filterer is a functional feeding group.
- Functional feeding groups can be found in the GA EPD Macroinvertebrate Taxa List.



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Filterer Taxa

Filterer Taxa = **# of Filterer taxa**

- The functional feeding group is used to determine if an individual is considered to be a Filterer taxa or not a Filter taxa.
- The functional feeding group can be found in the GA EPD Macroinvertebrate Taxa List.

Habit Metrics:

Clinger Taxa

Clinger Taxa = **# of Clinger taxa**

- The functional feeding group is used to determine if an individual is considered to be a Clinger taxa or not a Shredder taxa.
- The functional feeding group can be found in the GA EPD Macroinvertebrate Taxa List.

% Clinger

%Clinger = **100 * [# Individual Clingers / Total Individuals in sample]**

- Clinger is a functional feeding group.
- Functional feeding groups can be found in the GA EPD Macroinvertebrate Taxa List.

Burrower Taxa

Burrower Taxa = **# of Burrower taxa**

- The habit is used to determine if an individual is considered to be a Burrower taxa or not a Burrower taxa.
- The habit can be found in the GA EPD Macroinvertebrate Taxa List.



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SprawlerTaxa

Sprawler Taxa = # of **Sprawler taxa**

- The habit is used to determine if an individual is considered to be a Sprawler taxa or not a Sprawler taxa.
- The habit can be found in the GA EPD Macroinvertebrate Taxa List.

Swimmer Taxa

Swimmer Taxa = # of Swimmer taxa

- The habit is used to determine if an individual is considered to be a Swimmer taxa or not a Swimmer taxa.
- The habit can be found in the GA EPD Macroinvertebrate Taxa List.