Mill Brook Watershed Study Macroinvertebrate Analysis

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Sixty-two identifiable species of macroinvertebrates were collected during the Mill Brook Watershed Study. Numerous specimens of snails, fingernail clams and certain fly larvae could not be identified (snails and fingernail clams require live specimens for identification, and black fly and midge (fly) larvae require specialists and/or chromosomal preparation for identification).

Fifty species that were collected by Whitmore in 2007/2008 from sites including Mill Brook below Priester's Pond, the Unnamed Feeder stream flowing into Priester's Pond, and Witch Brook were not collected by the Mill Brook Watershed Study. Of these fifty species, twenty-five were collected by Whitmore from a date range outside of the June-August collecting dates used in the Mill Brook Watershed Study. In studies that focus on diversity, samples should be taken from the largest possible date range. Many species are present in larval form only from late fall-early spring and are not collected if streams are sampled only in the summer months. Species found in the summer months (July-August) tend to be those that are more tolerant of lower oxygen levels imposed by higher temperatures and organic pollutants. This means that by only sampling in the summer it can give a skewed view of the overall quality of the watershed if the presence/absence of certain macroinvertebrates are used as an indicator of water quality. This can be compounded by the presence of dams and lakes along the course of the stream, as these obstructions negatively affect water temperature and levels of dissolved oxygen, further impacting the species present in the streams.

Twenty species collected by the Mill Brook Watershed Study are new records for Martha's Vineyard. These species mainly consist of beetles and other slow-water species, found in backwater areas of slow-flowing streams or in lakes/ponds. Thirteen of these species were collected from sites not used by Whitmore.

Wascosim's, the upstream side of Fisher Pond, Witch Brook and the unnamed stream flowing into Priester's Pond are the least impacted collecting sites and can be looked to as a comparison for the pond/dam-impacted sampling sites in regards to species composition.

Fisher Pond is the site first significant obstruction of Mill Brook. The section from the source of the Mill Brook to the upstream side of Fisher Pond should be the least impacted (this includes the Wascosim's site). Fisher pond creates a shift in stream dynamics that is mirrored by all downstream ponds. Temperature readings were significantly higher below Fisher Pond in August and oxygen readings were significantly lower in August when compared to the June readings. Biodiversity Works took dissolved oxygen readings during the morning hours. Dissolved oxygen tends to fluctuate and may decrease as the day progresses and the water warms, particularly during the summer months. Low oxygen

readings during summer months are correlated with high temperature readings as well as increasing levels of organic pollutants. As water temperature increases, the amount of dissolved oxygen it can contain decreases. Organic pollutants include manure fertilizer, sewage, etc.. These substances make their way into streams via runoff from rainfall, leaking septic tanks or faulty leachfields. The amount of organic pollutants tends to increase in a body of water as summer progresses. Organic pollutants act as fertilizer for algae, which in turn leads to algal blooms. Algae are short-lived and when algae dies it is decomposed. Decomposers utilize large amounts of oxygen during the decomposition process, thus resulting lower dissolved-oxygen levels. Organic pollution tests typically consist of sampling for nitrogen, phosphorus, and fecal coliform bacteria. As these tests were not performed, the dissolved oxygen readings below Fisher Pond cannot be directly attributed to organic pollution, but it is a worthwhile consideration.

For the purposes of biomonitoring species are assigned tolerance values. A tolerance value is the point at which species are no longer able to survive due to increasing levels of organic pollution. Tolerance values and species occurrence records can be used to generate a Hilsenhoff biotic index, which evaluates the amount of organic pollution in a stream. The index can be calculated using the following formula:

INCLUDEPICTURE "http://cfb.unh.edu/StreamKey/html/biotic_indicators/indices/hilsenhoff_eq.jpg" * MERGEFORMATINET

The result of using this formula will be a value ranging from 0-10. This value can be interpreted using the following chart:

INCLUDEPICTURE "http://cfb.unh.edu/StreamKey/html/biotic_indicators/indices/FHBI_chart.png" * MERGEFORMATINET

A biotic index was completed for the following:

All sites combined- 4.75
Non-impacted sites vs. impacted sites- no significant difference
All sites combined without Sphaeriidae (fingernail clams) and Gastropoda (snails)- 3.85

A biotic index value of 4.75 is considered “good” and shows that some amount of organic pollution is likely present. This is common of most streams in developed areas. Biotic index values may have been negatively influenced by the sampling timeframe (summer), as summer species tend to be more tolerant of higher temperatures and lower amounts of dissolved oxygen. This could have caused the biotic index value to be higher than what could be expected if sites were also sampled in the winter, spring and fall. As no sites were sampled outside of the June-August timeframe there is no basis for comparison.
A combined biotic index for the least impacted sites (Wascosim’s, the upstream side of Fisher Pond, Witch Brook and the unnamed stream flowing into Priester’s Pond) was

calculated and compared to a combined biotic index calculated for the rest of the sites. There was no significant difference between the results. Witch Brook and the unnamed feeder flowing into Priester's were sampled at the terminus of the streams. The stream characteristics in these locations is markedly different than the upstream course of the streams. The water slows dramatically and the stream bottom becomes mucky. The fauna attracted to these sites has a higher tolerance for lower levels of dissolved oxygen. These factors may have negatively influenced the non-impacted/impacted biotic index. Samples taken upstream at both sites could yield more cold-water species with lower tolerance values, essentially lowering the biotic index value.

Due to the high abundance of Sphaeriidae and Gastropoda in a few samples, a separate biotic index was calculated without these groups. This value was significantly lower at 3.85. These groups have high average tolerance values (varies among species) and because they could not be identified to species level it is useful create a biotic index without these groups for comparison purposes. A value of 3.85 is considered "very good" and shows that slight organic pollution is possible. The high number of individuals in the disputed samples could be considered a sampling anomaly, as other similar sites had far lower abundance.

The impact of Fisher Pond on species diversity can be seen by the presence of two stoneflies (*S. marginata* and *L.ferruginea*) with low tolerance values in Mill Brook prior to Fisher Pond that are not present in the other sample sites. A mayfly (*P. debilis*) with a low tolerance value was found above Fisher and in the unnamed feeder stream flowing into Priester's. A caddisfly (*Lepidostoma sp.*) with a low tolerance value was relatively common upstream of Fisher Pond and was collected by Whitmore in the unnamed feeder stream flowing into Priester's, with a single record collected below Priester's. The single record could be an example of an organism living outside of its optimal range. The absence of three of these four species below the ponds may show that they are unable to survive due to the changes in water quality and stream dynamics resulting from the ponds.

Above/below pond species comparison:

Fisher above- 16 species
Fisher below- 20 species
Fisher total species-31
Fisher species found at both sites- 5

Crocker above- 7 species
Crocker below- 14 species
Crocker total species- 18
Crocker species found at both sites- 3

Priester's above- 15 species
Priester's below- 20 species
Priester's total species- 31
Priester's species found at both sites- 4

Albert's above- 5
Albert's below- 9
Albert's total species- 14
Albert's species found at both sites- 0

All four sites show a higher species diversity below the ponds. This is due to the riffle habitat being present below the ponds. The number of shared species above/below ponds at all four sites is quite low. This shows that the ponds have a definitive influence on species composition at all four sites. Sites above the ponds are slow-flowing sites with muddy/silty bottoms, more organic debris and aquatic macrophytes. Sites below the ponds are moderate-flowing sites with cobble/sandy bottoms and less organic debris and aquatic macrophytes. These differences in stream composition affect the species that utilize the collecting sites. Species diversity tends to increase along the course of a stream and the stream increases in size. This is due to an ever-increasing amount of organic material being present in the stream as it progresses. This natural progression is not seen in Mill Brook, as Fisher sites and Priester's sites have the highest diversity. Diversity at Priester's may be artificially inflated by the presence of numerous species typical of Priester's pond being found at the Priester's sites.

The dams and ponds have influenced the suite of species found in Mill Brook. Mill Brook should be a cold-water, moderate-flowing stream throughout its entire course. The dams/ ponds increase temperature, decrease oxygen, decrease the overall riffle habitat and create impenetrable barriers for the migration movement of fish and the daily downstream drift of macroinvertebrates. They provide a slow-water habitat above the dams that attracts a different suite of species typical of such sites. This suite of species is not typical of a cold-water stream. As there is no baseline documentation prior to dam installation, it is difficult to determine what a pristine fauna would be. In this regards the dams may have altered the species present by attracting species more adapted to living in slow or warmer-water environments. The higher temperatures and lower levels of dissolved oxygen created by the dams may have killed off more sensitive species in the past.

The following is a list of fifty species collected by Whitmore in 2007/2008 from Mill Brook below Priester's Pond, the Unnamed Feeder stream flowing into Priester's Pond, and Witch Brook that were not collected in the Mill Brook Watershed Study:

* Designates species collected from a date range outside of the June-August collecting dates used in the Mill Brook Watershed Study. Species diversity totals for all sampling

sites were clearly negatively influenced by the short sampling season. Ideally sites should be sampled each month of the year, but sampling from March-October can give a reasonable representation of the fauna present in the streams.

Coleoptera- beetles

**Neohaemonia melsheimeri*- below Priester's in May

**Acilius semisulcatus*- below Priester's in April

**Neoporis undulatus*- below Priester's- in April

Optioservus ovalis- below Priester's from March-September and Priester's feeder in September

Peltodytes muticus- Priester's feeder from May-July

**Peltodytes shermani*- below Priester's in July and Priester's feeder in April

Ephemeroptera-mayflies

Acentrella parvula- below Priester's from May-July and Priester's feeder in May

Callibaetis fluctuans- below Priester's from March- August

**Centroptilum triangulifer*- Priester's feeder in April

**Heterocloeon amplum*- below Priester's in May

Pseudocloeon propinquum- below Priester's in May and Priester's feeder from May-September

Leptophlebia cupida- Priester's feeder from April-September

**Leptophlebia nebulosa*- below Priester's from March-April and Priester's feeder in April

Hemiptera- true bugs

Belostoma flumineum- Priester's feeder in September and October

Belostoma lutarium- below Priester's from July-September

Mesovelia mulsanti- below Priester's from July-September

Pelocoris femoratus- below Priester's from May-August

Notonecta irrorata- Priester's feeder from April-September and Witch Brook in March

Notonecta lunata- below Priester's from August-September

Neoplea striola- Priester's feeder from May-June

Megaloptera- dobsonflies, fishflies and alderflies

Chauliodes pectinicornis- Priester's feeder from April-August

Chauliodes rastricornis- below Priester's in July and Priester's feeder from May-July

**Sialis velata*- Priester's feeder in April

Odonata- dragonflies and damselflies

**Aeshna umbrosa*- Priester's feeder in May

Anax junius- below Priester's in September

Anax longipes- below Priester's in August

Calopteryx maculata- below Priester's from March-September and Priester's feeder from May-October

Tetragonuria spinosa- below Priester's from May-August

Plecoptera- stoneflies

Leuctra variabilis- below Priester's in July

**Paraleuctra sara*- Witch Brook in March

**Prostoia completa*- below Priester's in March

Trichoptera- caddisflies

**Brachycentrus americanus*- below Priester's in April

Ceratopsyche sparna- below Priester's from April-September and Priester's feeder from April-August

**Diplectrona modesta*- Priester's feeder in April

**Ceraclea alagma*- below Priester's in May

**Oecetis persimilis*- below Priester's in May

**Triaenodes ignites*- below Priester's in March

**Anabolia consocia*- Priester's feeder from April-May

**Ironoquia punctatissima*- below Priester's and Priester's feeder in April

Pycnopsyche guttifera- below Priester's in April and Priester's feeder from May-August

**Pycnopsyche lepida*- below Priester's in March

Pycnopsyche scabripennis- below Priester's in April and Priester's feeder in July

**Oligostomis pardalis*- Priester's feeder from April and October Witch Brook in March

Cernotina spicata- below Priester's in July and Priester's feeder from April-August

**Nyctiophylax uncus*- Witch Brook in March

**Lype diversa*- Priester's feeder in September

**Rhyacophila carolina*- Witch Brook in March

**Rhyacophila glaberrima*- Priester's feeder in April

**Rhyacophila sp*.- below Priester's in September

Neophylax concinnus- Priester's feeder in July

Diptera- flies

-several species of Chironomidae and Simuliidae collected by Whitmore that were identified by specialists are not included here because they could not be identified for this study

Sphaeriidae- fingernail clams

-numerous specimens were collected during this study that cannot be identified, as live specimens are needed

Gastropoda- snails

-numerous specimens were collected during this study that cannot be identified, as live specimens are needed

Four spreadsheets have been created to supplement this report. Three of the spreadsheets include the species presence/abundance per sampling site/date. The fourth spreadsheet includes species abundance, tolerance values for each species and new records for Martha's Vineyard.