# A Comprehensive Analysis of Benthic Macroinvertebrate Diversity on the Susquehanna River At the Byers Island Transect from 2009-2012

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SRHCES Susquehanna River Heartland Coalition for Environmental Studies

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## Introduction

•Benthic macroinvertebrates are significant indicators of stream health (Flotemersch et al. 2006) and integrate environmental conditions over annual cycles.
•Diversity of the benthic macroinvertebrate community allows for stress tolerances for pollution to be assigned (Hilsenhoff 1988).
•Passive methods of biomonitoring benthic macroinvertebrates include artificial habitats using natural substrates that they colonize until collection (Johnson et al. 2006). The use of artificial substrates like rock baskets and Hester-Dendy multiplate samplers allow for direct comparisons between sites.
•The purpose of this study is to generate base-line macroinvertebrate information at the Byers Island Transect (Figures 1-2).

Figure 1: The team at site 4 preparing to deploy the rock baskets

## Site Description

•Sites 1-4 are accessible through Shady Nook in Selinsgrove, PA about seven kilometers below the confluence of the North and West branches of the Susquehanna River (Figure 2).
•Site 5 is located above the Sunbury Generation Power Plant in Shamokin Dam, PA approximately two kilometers away from Shady Nook.
•All sites are below the Adam T. Bower inflatable dam and sites 1-4 are below low head dams.
•Sites 1 and 5 receive water from the West branch.
•Sites 2, 3 and 4 receive water from the North branch.
•Site 3 frequently experiences periods of very low flow.
•Site 4 is impacted by acid mine drainage from Shamokin Creek.

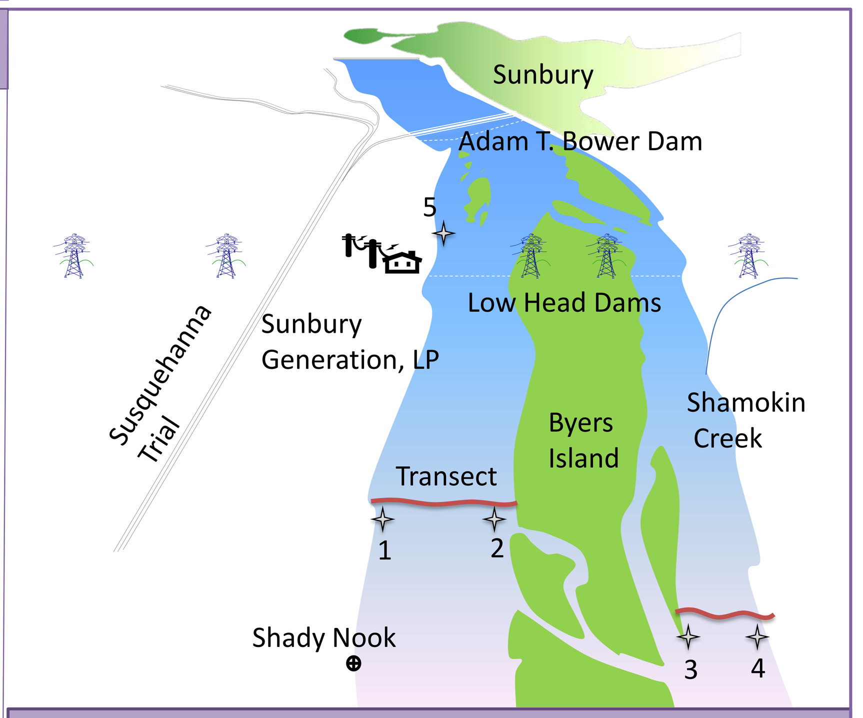



Figure 2: Image of Byers Island and site locations along the Susquehanna River.


## Abstract

The Susquehanna River ecosystem has been monitored for macroinvertebrate composition during the summer months of 2009, 2010, and 2012. Macroinvertebrates are significant determinants of stream health based on how sensitive they are to pollution. Our study utilized artificial substrates, rock baskets and Hester-Dendy samplers, at sites on the upper main stem along a transect that straddled Byers Island near Shamokin Dam, PA. The collection and identification of these organisms to family allowed us to determine pollution tolerance values and other comparative metrics. During the study, biological diversity declined as Ephemeroptera, Decapoda, and Amphipoda began to dominate causing the Hilsenhoff Biotic Index values to rise, and the percent EPT to fall. Overall, the pollution-tolerant macroinvertebrates increased in relative dominance since 2009; however, the difference likely is related to summer discharge levels. Our results underscore the need for more bioassessment studies to cover a wide range of flow regimes.


## Methods

### Field Methods (Flotemersch et al. 2006)

- Fifteen rock baskets filled with limestone rock were deployed.
- At sites 1, 2, 3, and 5, three rock baskets were set into a diamond pattern with three Hester-Dendy samplers being at the southernmost point of the diamond.
- At site 4, three rock baskets were deployed in a line from north to south with three Hester-Dendy samplers forming the southernmost point of the line.
- The baskets were monitored for six weeks before collection.
- Using a sieve bucket, rock baskets and Hester-Dendy samplers were cleaned of invertebrates, which were stored in 95% ethanol.

### Laboratory Methods

- Samples were separated and identified to family using Merritt et al. (2008), Peckarsky et al. (1990), and Voshell (2002).
- Pollution Tolerance Index (PTI) values were assigned based on Family (Hilsenhoff 1988).
- Using the Pennsylvania Department of Environmental Protection's Bethic Index of Biotic Integrity (2009), the following metrics were employed: Shannon Diversity Index, Hilsenhoff Biotic Index, and Percent EPT

## Discussion

### Discharge (Figure 3)

- 2009 and 2011 were years with extended periods of high water during the summer.
- 2010 and 2012 were dry periods with low discharge through most of the summer.

### Percent EPT (Figure 4)

- Few Plecoptera and Tricoptera in 2010 and 2012
    - May be related to discharge and overall water temperature
- Sites 2 and 3 saw a very large relative increase in Ephemeroptera during years of low discharge.

### Hilsenhoff Biotic Index (Figure 5)

- All sites in 2012 except site 4 increased in pollution tolerant taxa.
- Site 5 falls into "good" category of degree of organic pollution
- Sites 1-4 are in "very good" category with slight pollution

### Shannon Diversity and Percent Composition (Figures 6-9)

- Higher diversity at Sites 2-4 in waters of North Branch
    - Fewer organisms found at these sites possibly due to being disturbed with substantial decline in water level
- Lower diversity usually signifies a fading presence of pollutant-intolerant macroinvertebrates
- In 2010 and 2012, some organisms were affected by chemical and physical changes surrounding low water events decreasing diversity

We interpret the differences in the macroinvertebrate communities between years to be responses to levels of discharge especially during the summer months. We recognize the need to be cautious in interpreting only three years of data; however, the precipitous declines in %EPT, (Figure 4) during the two dry years (2010 and 2012), driven mainly by the loss of Plecoptera and Trichoptera taxa (Figures 7-9), suggest other discharge-related phenomena (e.g. temperature, oxygen) may be responsible for the differences. A similar relationship can be seen in Shannon Diversity (Figure 6).

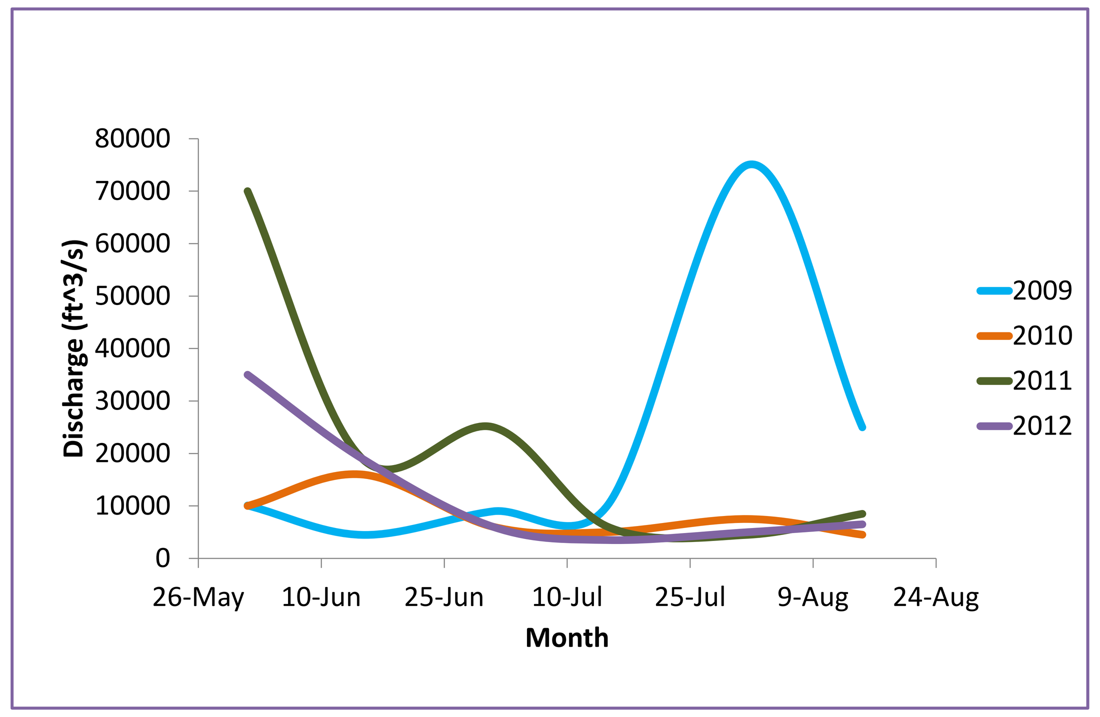



Figure 3: Discharge values (in ft³/s) from June 1 to August 15 for years 2009-2012 measured at the Sunbury station

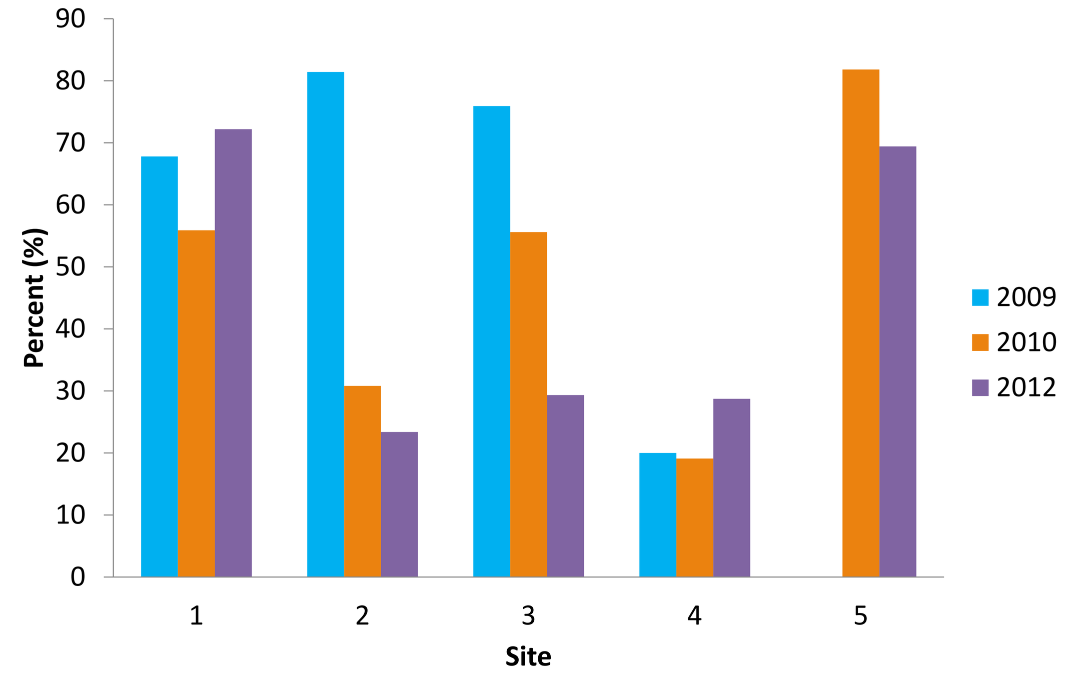



Figure 4: Percent Ephemeroptera, Plecoptera, and Tricoptera (EPT) for the years 2009-2012, excluding 2011

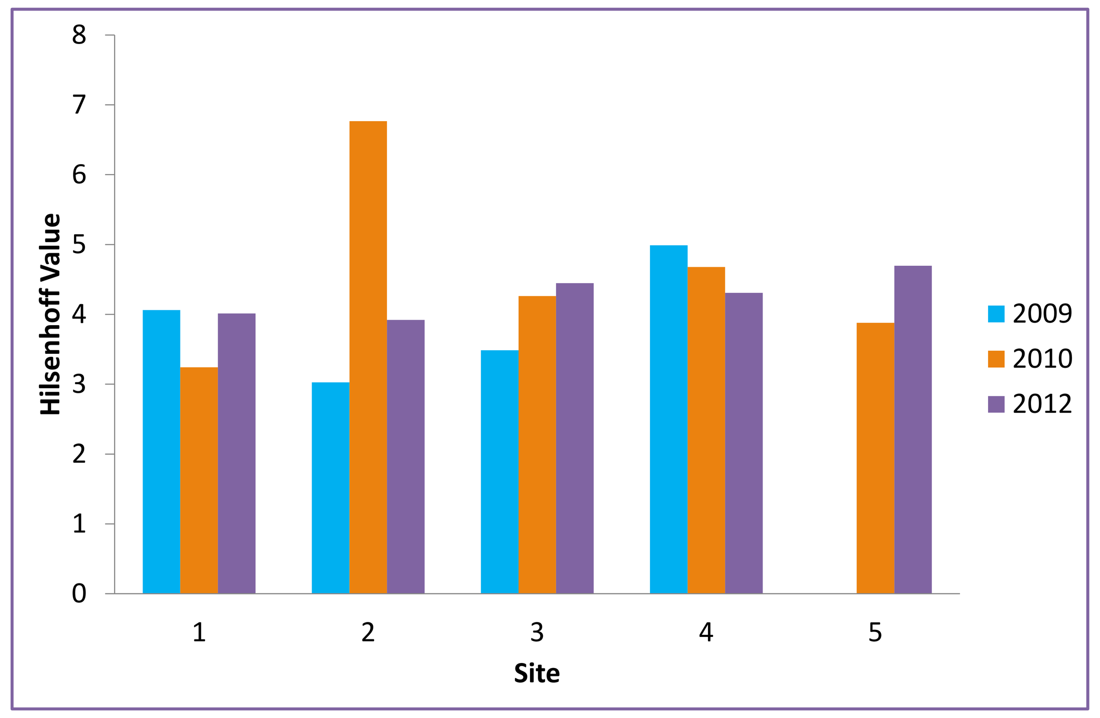



Figure 5: Hilsenhoff Biotic Index values for the years 2009-2012, excluding 2011

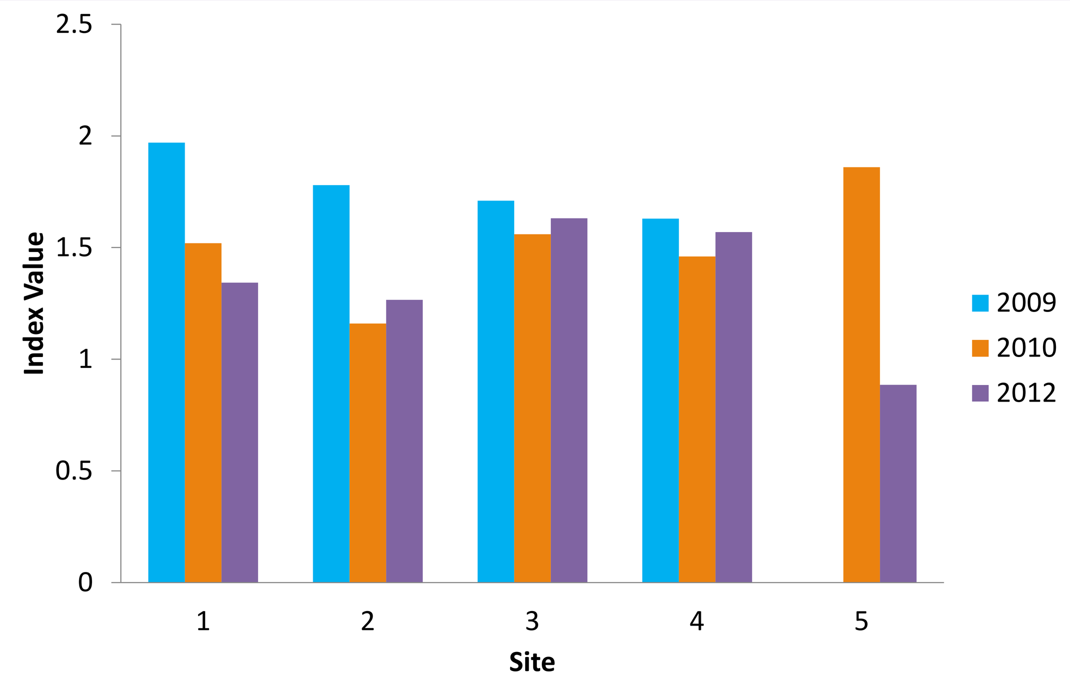
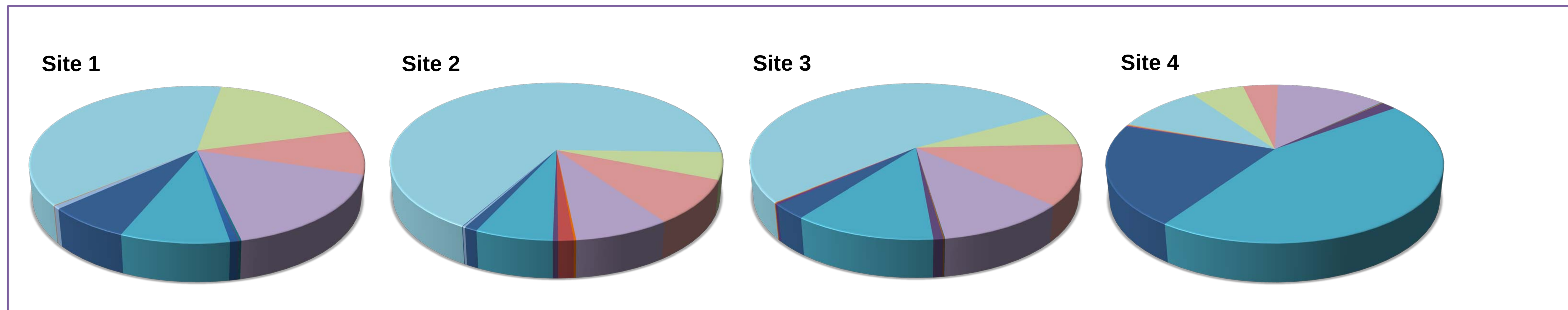



Figure 6: Shannon Diversity Index values for the years 2009-2012, excluding 2011



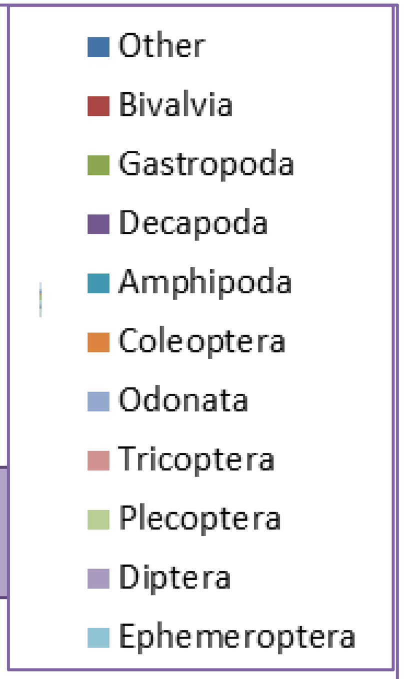




Figure 7: Percent composition of macroinvertebrate orders for Sites 1-4 from the 2009 collection

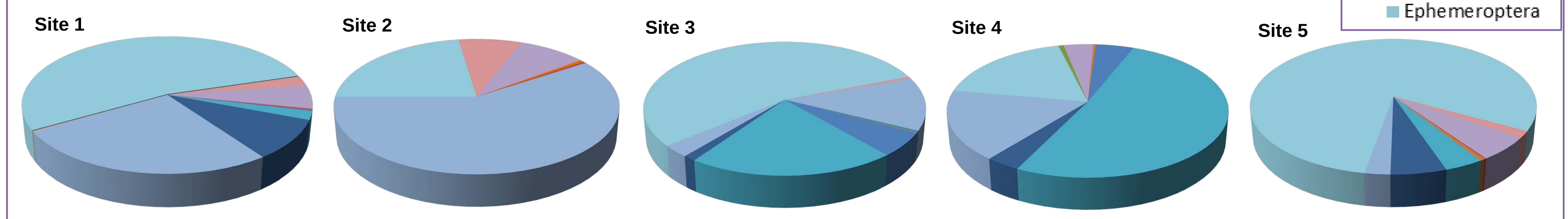



Figure 8: Percent composition of macroinvertebrate orders for Site 1-5 from the 2010 collection

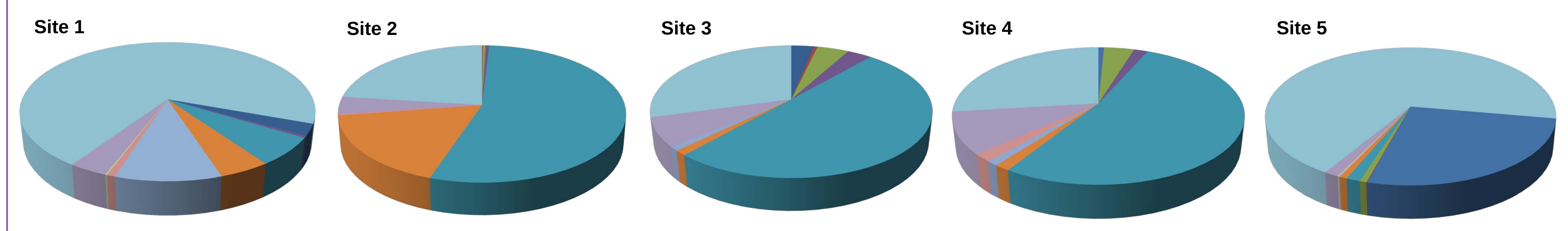



Figure 9: Percent composition of macroinvertebrate orders for Site 1-5 from the 2012 collection