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Assessing the Relative Health of the Eugene Millrace via Macroinvertebrate Study

Introduction

The Eugene millrace is a slough of the Willamette river that runs North of the University of Oregon. While once a natural geologic feature, the development of the millrace to incorporate it into urban life has vastly changed its form and function. As the millrace has changed over time, so too has its uses and perceptions. Although once intended for industrial use, the proximity to the University of Oregon made an ideal location for recreation. As the flow through the Eugene millrace eventually slowed due to damage to the intake channel as well as neglected maintenance, attitudes towards the millrace shifted. Once a flowing stream, the millrace became a 1.5-mile-long pond. The smell, accumulated sediment, bugs and perceived dirtiness led the students and public to avoid interacting directly with the millrace. The purpose of this study focuses on this question: is the Eugene millrace polluted compared to other natural ponds in the area?

Evaluating stream health is a complicated question with multiple imperfect approaches. Chemical and physical properties give an indication of the kind of environment that exists in a particular place, but assessing the biological component demonstrates what actually lives there and can show the healthiness (or unhealthiness) of a given aquatic environment.

In particular, the macroinvertebrate community can give an indication of the broader biological system. These benthic invertebrates break down detritus, making available vital nutrients to other trophic levels (Covich et al., 1999). Sensitive species are those in the orders *Ephemeroptera* (mayflies), *Plecoptera* (stoneflies), and *Trichoptera* (caddisflies) (Oregon Governor's Watershed Enhancement Board, 1999). Because the millrace is located in an urban

area, and the water appears stagnant, I hypothesized that the Eugene millrace would have a less healthy macroinvertebrate community when compared to other natural sloughs in the area.

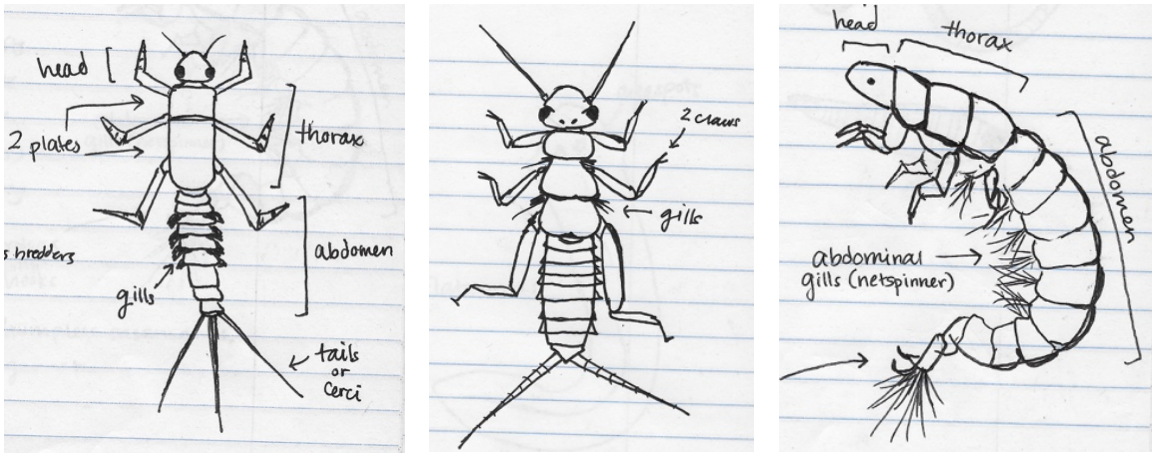

Figure 1. Diagrams of three sensitive aquatic species: *Ephemeroptera, Plecoptera,* and *Trichoptera*, respectively. Diversity in families or genera of these orders gives a better understanding of the taxa richness and stream health (Oregon Governor's Watershed Enhancement Board, 1999).

Materials & method

Technique for sampling was drawn from the Oregon Plan for salmon and watersheds water quality monitoring technical guidebook. These methods are generally recommended for assessment of stream habitats and required flowing water but could be modified for the evaluation of slow-flowing water like the millrace pond. Sampling involved using a D-frame kick net, disturbing the stream bed, and using sieves to sort and wash the sample.

Choosing a suitable control site was important to make appropriate comparisons between the millrace pond and other naturally occurring sloughs in the Willamette Valley. I chose not to sample the Willamette River directly, because the physical environment of an active stream is significantly different from the still waters of a pond. The comparison slough chosen had calm waters similar to the millrace pond, and both were visually comparable.

Furthermore, the two sites were geographically close and would have similar upstream conditions.

Figure 2. Relative location between the millrace pond and the river pond sampling sites

Analysis of data included calculating species richness (total number of species present), relative abundance, and several measurements of biodiversity including Simpson's index ($D = \Sigma {P_i}^2$), Shannon-Wiener index ($H = -\Sigma[P_i \ln(P_i)]$), and evenness ($E = \frac{H}{\ln(S)}$).

Results

The millrace pond had higher species richness and more evenness as compared to the river pond. Although the river pond did have a much higher proportion of mayflies (*Ephemeroptera*), both sites supported populations of sensitive species. However, both also had a majority of tolerant to very tolerant species of invertebrates. In general, there were a statistically significant difference in the numbers of kinds of macroinvertebrates found in both sites.

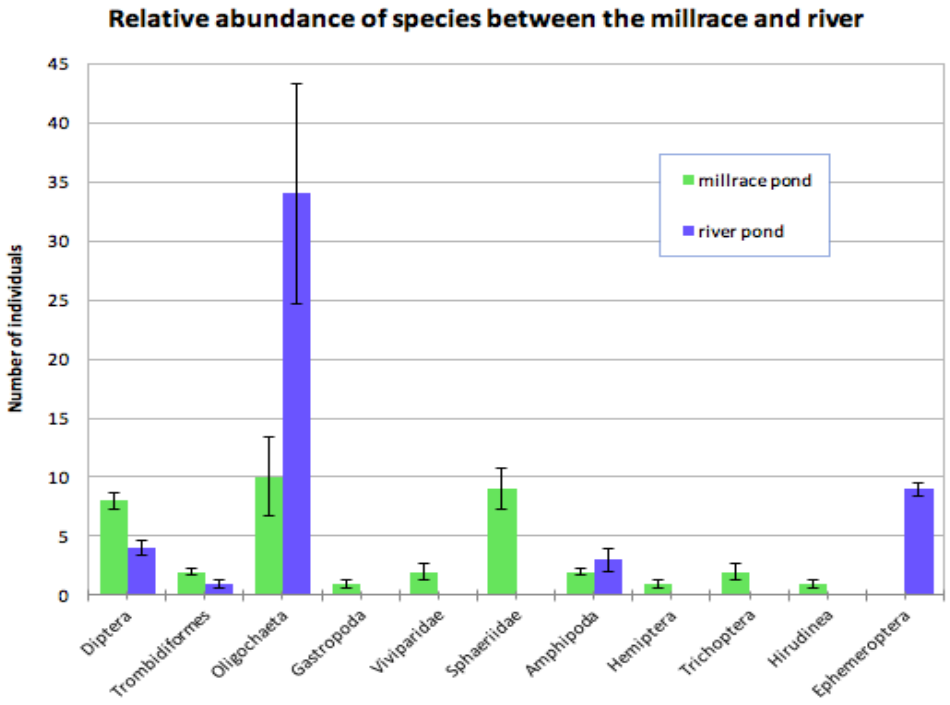

Figure 3. Relative abundance of species compared between the millrace pond and river pond.

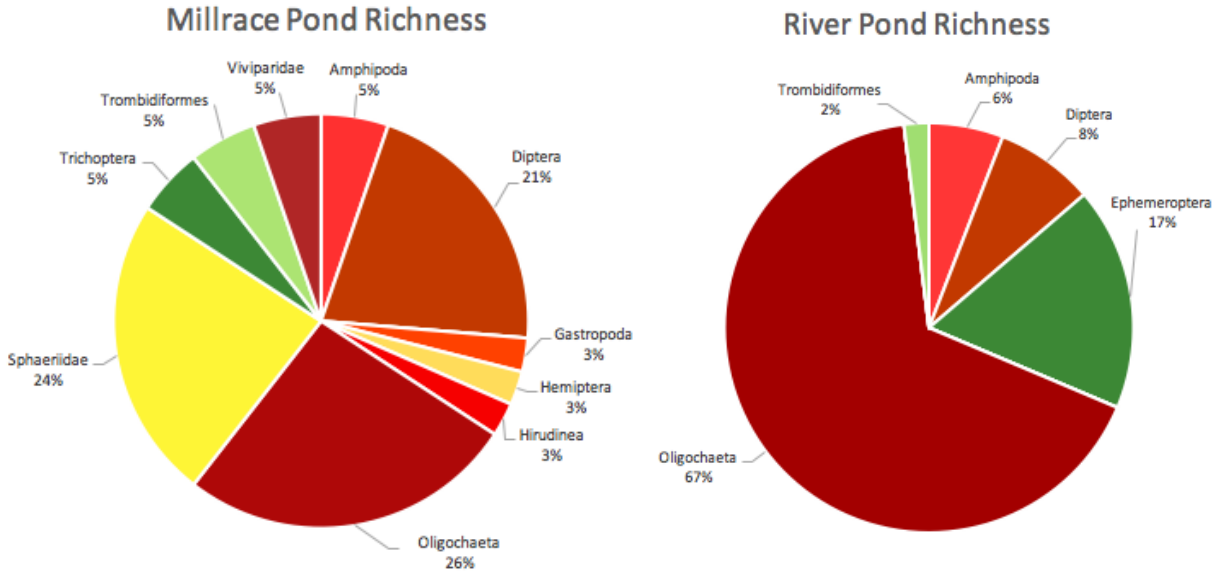

Figure 4 and 5. Comparison of species richness between the Eugene millrace pond and the river pond. Red designates very pollution-tolerant species. Yellow designates tolerant species. Light green shows somewhat-sensitive species, and dark green are very sensitive to pollution.

	Species richness (S)	Simpson's index of diversity (1-D)	Shannon-wiener index (H)	Evenness (E)
Millrace pond	10	0.817	1.93	0.837
River pond	5	0.514	1.02	0.634

Figure 6. Several measures of biodiversity are useful in quantifying diversity and evenness based on probability. Species richness is the absolute number of different species found. Simpson's index of diversity represent the chance that two randomly-chosen organisms are different species. Shannon-wiener index takes into account the amount of order or disorder within an ecological system. Evenness compares the relative abundance between the species found in a location. (Maryland Sea Grant).

Discussion

Although popular perceptions of the Eugene millrace characterize it as a polluted pond, it has a healthier macroinvertebrate community than a slough of the Willamette river. However, by the standards of the Oregon Governor's Watershed Enhancement Board, neither places are considered 'healthy' as both contain mostly pollution-tolerant species. The evaluation criteria used in this study was designed for the assessment of habitat for salmon (*Oncorhynchus* spp.), but it's unlikely that salmon would be taking advantage of these shallow, warm-water areas anyway. Although pond ecosystems are less picturesque and appealing to our cultural aesthetic values, ponds provide valuable functions including linking aquatic habitats and nutrient cycling (Céréghino et al., 2008). Benthic macroinvertebrates accelerate decomposition of organic material, making available food and other nutrients to different trophic levels, even if they may be associated with pollution (Covich et al., 1999).

In order to better evaluate the health of the Eugene millrace, we must look at it from the perspective of a pond ecosystem instead of assessing it like we would streams or rivers. Furthermore, it would be necessary to compare to other natural sloughs and ponds around Eugene, OR, as well as to determine how macroinvertebrate communities change over time.

References

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