Summary Report of Oregon Abroad Student Projects
UO Millrace Spring 2017
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In this report, we summarize the findings of our students in the following categories: history, geology & hydrology, water quality, vegetation and wildlife associated with the millrace. We also make recommendations based on what we learned over the course of Spring term 2017. The student projects are referenced by their last names in this report. Their papers, supporting data and presentations will be given to the UO libraries for preservation and access.

History

Eugene's power canal or "millrace," was built by early settlers in the 1850s by combining two natural side channels (sloughs) with a short (approximately 4 blocks) dug canal. It is a complex but integral physical, natural, historical, and cultural feature that has shaped the city's dynamic past and continues to reflect and affect its present and future. If it's true, as the ancient Greek philosopher Heraclitus famously observed, that one "cannot step into the same river twice," the same goes for the Eugene millrace. It was designed to advance Eugene's pioneer agricultural economy and manufacturing and then, as its waterpower proved inadequate or unreliable, it became a site for recreation, aesthetic pleasure, and local identity. By the mid-twentieth century the millrace suffered from neglect and abuse, which, over the next half century to the present the city and university community sought to address, though fitfully and with difficulty (see esp. *Eugene Millrace: A History*).

Brian Mayne showed that the millrace was critical to the initial development of Eugene's economy but that its impact was limited in scale and time—it was never likely to make the city an industrial power or major commercial center. With shifting technologies, not to mention a shifting Willamette River, the millrace became economically obsolescent by the end of the nineteenth century, and since that time simple economic justifications for its restoration have never been viable. Nonetheless, the millrace assumed new importance as a focus of recreation and cultural identity, with students and city residents integrating the artificial watercourse into their social lives (Hatton). As Eugene grew rapidly in the post-World War II period, as the city and country experienced fits of social and economic change and environmental alteration, the millrace suffered bouts of neglect and degradation, punctuated by burst of attention and restoration, particularly to maintain flow and remove trash. Paradoxically, as a new environmental activism emerged in the 1970s, especially on college campuses, the millrace's environmental quality seemed to decline, despite the earnest, occasional efforts to clean it up (Titterington).

Geology and hydrology

Lidar images clearly show the millrace to be largely composed of two natural side channels that have been linked by a short man-made canal. The current peak annual discharge (i.e., flow rate) of the millrace is nearly 10 times lower than historic values that facilitated diverse recreation as documented in UO archives (Younquist, Hatton). Currently, flow is derived from stormwater drainage during the winter months and pumping near the upstream end of the millrace during the summer. As a result of chronically reduced flow in recent decades, sections

of the millrace have experienced substantial sediment deposition, exceeding 6 feet in thickness at many locations (Niyangoda). Substantial increases in flow would likely promote entrainment and transport of fine-grained sediments that would generate high turbidity. Thus, sediment excavation (dredging) would likely be necessary prior to increases in flow.

Water Quality

The Millrace is currently functioning as a bioswale, reducing the silt and pollution present in the storm waters that are emptied into it before it reaches the river. The preliminary chemical testing (Erickson) and macroinvertebrate surveys (Lyle & Valente) the students did strongly suggest that the Millrace is not "horribly" polluted. In fact, the Millrace had greater macroinvertebrate richness and more pollution intolerant species (Fig. 1 a & b) than the appropriate comparator side channel (slough) in the Willamette River immediately across the river in Alton Baker Park (Fig. 1c). Water chemistry tests (Erickson) revealed no or only trace amounts of copper, iron, phosphate, nitrites and nitrates in the Millrace, and slightly higher amounts of these in the comparative side channel in Alton Baker Park. The physical characteristics (dissolved oxygen, pH, temperature, light) of the Millrace indicate that it could support salmon (Meyer).

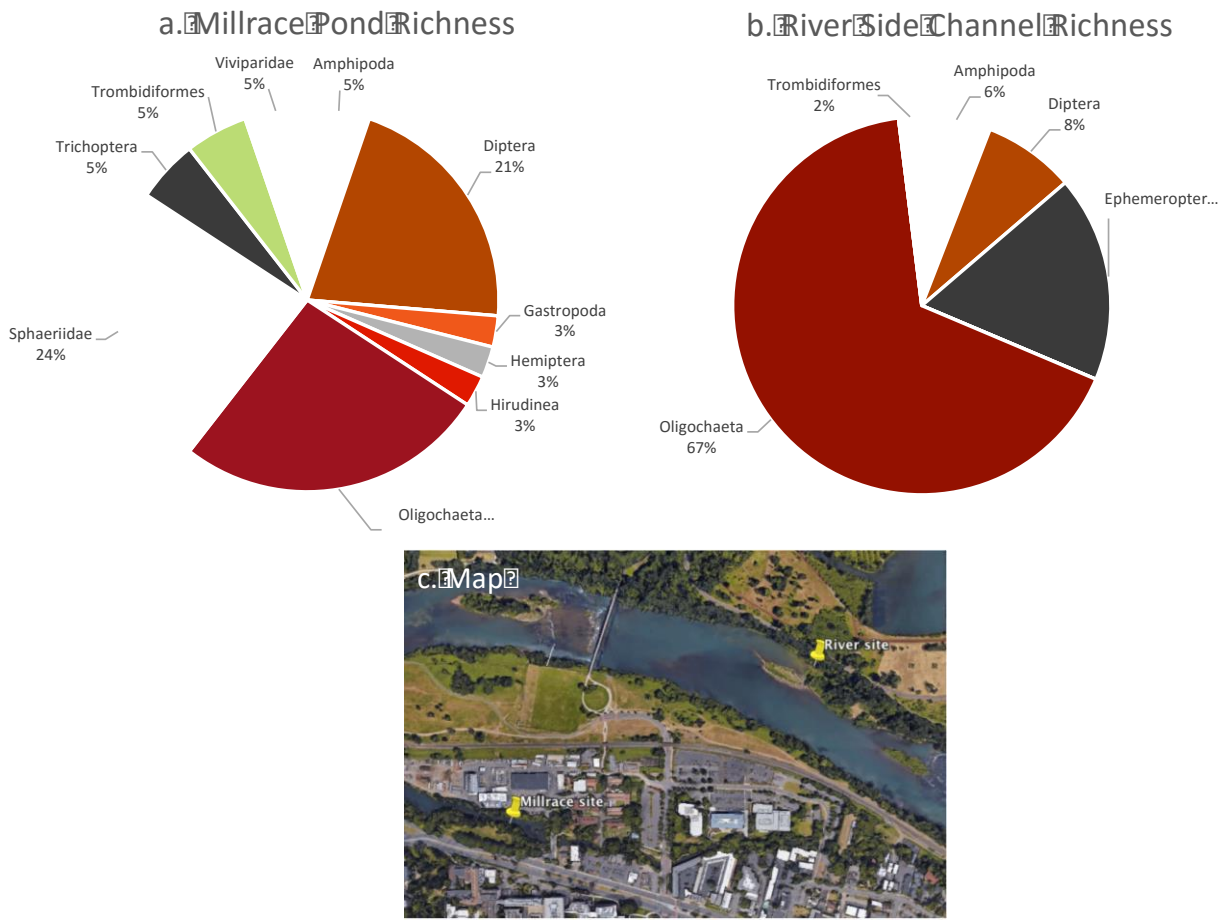

Fig. 1 from Lyle's report on macroinvertebrates. a. Millrace Pond species richness, b. River side channel (slough) species richness, c. map showing Millrace pond and comparative river side-channel in Alton Baker Park.

Vegetation and wildlife

The vegetation on the Millrace is currently a combination of planted non-natives (some of which are invasive), invasions of blackberry and ivy as a result of high light and disturbance and neglect, and natural succession (Millrace List 2017 and Wentlandt). At the pump end, the overstory is dominated by native cottonwoods, red and white alder and bigleaf maple, in the area from the research park to the millrace pond, the overstory is a mixture of native and non-native trees, whereas the pond overstory is largely non-native oak trees. Blackberry and ivy form dense shade below them and are eliminating natural regeneration of native trees (Wyatt).

Over the term the students and faculty were able to identify a number of birds and animals using the Millrace (See Millrace 2017 list). We identified 27 native species of birds (more unidentified species were present), with the most exciting being a pair of peregrine falcons. Native animals included: gray squirrels, raccoons, garter snakes as well as insects and spiders. Non-native animals included: bullfrogs, fox-squirrels, house cats and nutria.

Recommendations

Our students' research suggests that students and citizens continue to value (or are open to again embrace) the millrace as a biological, cultural and aesthetic feature in the life of our community. They see it as a reflection on our university and city, and as such they might well support restoration or renovation efforts materially, particularly through voluntary labor. Residents, businesses, and especially fraternities and sororities located along the millrace have a vested interest in it, which could translate into commitment to community service projects on behalf of its cleanup and maintenance (Hatton). Eugene civic organizations as well as university student groups might also be mobilized. It seems clear, though, that ad hoc or voluntary efforts to address millrace degradation have not been successful and that sustaining the millrace—in whatever renovated form it takes—will require ongoing, systematic oversight and coordination. Adequate water levels and flows in the millrace are likely to be important to users aesthetically and recreationally. Satisfying such expectations should be reconciled with the need to maintain habitats, of course, and will require (perhaps increase) pumping expenses.

The millrace is also an important historical site worth appreciating and preserving, as Eugeneans have appreciated for decades. As a living history site it enhances the life of the university and city. As a unique hybrid landscape feature in our urban ecology—simultaneously natural *and* artificial—it represents a sort of "second nature," embodying our intertwined human and nonhuman history. Even its ruins—for example those sections above the current pumping station, including the old millrace intakes—are important relics that have historical value in telling the story of Eugene's past and its connection to a larger history of Oregon, the West, and the U.S. "Curating" historical and natural historical sites along the millrace might be easily accomplished through appropriate signs or markers (see for example, Sheehan). Our specific recommendations are enumerated below.

HISTORICAL AND CULTURAL PRESERVATION AND COMMUNITY OUTREACH

1. Consider the significance of the millrace as "second nature"--as a hybrid natural and cultural landscape of great value to the university community (and to Eugene generally) historically, culturally, aesthetically.

2. Meet with university and community groups (particularly those located along the millrace itself) to develop coordinated projects, including volunteer work, to renovate and maintain the millrace.

3. Create and erect interpretive markers or signs to explain and illustrate the history and natural history of the millrace as both relic and living historical landscape.

4. Feature the millrace as an integral part of the university, its history and its future, both as an aesthetic campus asset and as an embodiment of the university's bond with and commitment to the city of Eugene and Oregon.

WATER QUALITY and FLOW

5. Test the Millrace outflow for water quality. Our preliminary tests suggest the Millrace is not very polluted. However, we did not test the Millrace outflow, which would determine exactly how well the Millrace is functioning as a bioswale, and our sampling was limited to April and May when stormwater is not a large contributor. Furthermore, we did not test for fecal coliform bacteria, and a deeper macroinvertebrate survey should be done to more closely examine the presence of pollution tolerant species. Because the students were just learning macroinvertebrates, their examination was fairly coarse, with most identification made only to the level of order. Note that since the Millrace has intermittent to low flow, invertebrate comparisons should not be made to rivers but to similar side channels (sloughs) and ponds.

6. The ability of the Millrace to act as a bioswale could be improved by planting emergent native sedges and rushes in the hydric zone.

7. Litter should be removed. Perhaps a fraternity could volunteer to clean it on an annual basis? (This might reduce the littering too, due to personal responsibility).

8. Regarding the occasional foul odor. The odor is associated with the production of hydrogen sulfide when the pumps are off and decomposing anaerobic sediments are exposed (Sturman 2008); it is not a sign of pollution. The odor could be alleviated by having year-round flow. However, note that increased flow might decrease the bioswale capacity since the ability of low growing vegetation in the channel hydric zone to grow could be reduced. Also, note that more constant flow would alter the macroinvertebrate fauna from more of a pond community to one more similar to a stream. Right now, flow is intermittent and this has dramatic effects on aquatic life (Bunn and Arthington 2002).

9. Recreational use would require increased flow. The discharge necessary for boating and other forms of recreation is much higher than is currently being supplied by stormwater inputs and pumping at the Willamette river intake. As an alternative option, the Springfield millrace features a passive hydrologic connection with the river that doesn't require pumping or management although the water level during summer tends to be relatively low.

VEGETATION AND WILDLIFE

10. Plant only native plants along the Millrace and River. There are several reasons for this recommendation: (1) Waterways are vulnerable to invasions due to the availability of water,

and water transports seeds thus exporting invasions (Planty Tabacchi et al. 1996). (2) Non-native trees and shrubs support far fewer birds and butterflies than natives do (Tallamy 2007, Burghardt et al. 2009). For example, gingko support only three caterpillar species and native oaks more than 500 (Tallamy 2007). No insects=no birds or butterflies. (3) The composition of leaf litter falling into the water affects the aquatic macroinvertebrate communities that salmon and other fish depend on (Reinhart and VandeVoort 2006, Claeson et al. 2014).

11. Remove invasive blackberries, ivy and knotweed as they are limiting regeneration of native trees and shrubs (Wyatt), and they produce monocultures that reduce overall biodiversity and aesthetics.

12. Replace the invasive understory with a native one. There are several lovely native shrub species that would be beneficial for birds and wildlife **and** be less unpleasant to walk through (for example, snowberry , oceanspray, Pacific ninebark , Douglass spirea , red-twig dogwood, elderberry, mock-orange, red-flowering currant, and willows. The upper part (towards the inlet pump) of the Millrace has an overstory of native trees, but an understory of ivy and blackberries. This area could be restored with minimal effort by clearing the invasive understory and replacing it with natives. The City of Eugene has shown how this can be done; see the Delta ponds restoration (https://www.eugene-or.gov/Facilities/Facility/Details/Delta-Ponds-133).

13. Plant native rushes and sedges in the shallow sections to increase bioswale capacity and improve habitat for birds and aquatic life.

14. Increase the cover by native trees to reduce water temperatures. The Millrace is warmer than the river; warm water harms salmonid development.

List of Student Projects

- Archer, Shannon. Biodeterioration Watercolors.
- Erickson, Casey. Preliminary Evaluation and Critique of the Millrace Pond Suitability for Swimming
- Hatton, Tia. Without a Canoe.
- Lyle, Joanna. Assessing the Relative Health of the Eugene Millrace via Macroinvertebrate Study
- Mayne, Brian. Insufficient Flow: An Economic History of the Eugene Millrace
- Meyer, Trevor. A Study of the Physical Habitat and the Suitability of the Water Chemistry to Sustain Aquatic Communities
- Millrace List 2017. Xls file from Oregon Abroad "Place Project", in which the students determined what lived along the millrace (plants, animals, birds, insects).
- Mustain, Demetrius. We Can Still Run the Race.
- Niyangoda, Ethan. An Introductory Sedimentological Analysis of the Eugene Millrace
- Ogren, Grace. Making Different Types of Art Focusing on the Millrace.
- Pennington, Robert. Environmentalism and Art.
- Phillips, Galen. One-Act Play
- Sheehan, Kerry. Newberry Preschool Millrace Curriculum.
- Titterington, Sylvia. The Environmental Movement of the United States and How It Relates to the Decline of a Once Great Feature of Eugene
- Valente, Sean. Macroinvertebrate Sample.

•Wentlandt, Tanner. Succession at the Eugene Millrace Pond: 2017, 1963, and Analogs for the Older Pond

•Wyatt, Megan. Tree Saplings in the Eugene Millrace: Possible Correlation Between Blackberry Growth and Diminishing Riparian Tree Diversity

•Youngquist, Leah. A discussion on the Historical, Present, and Future Flow of the Millrace

Additional Literature Cited

Bunn, S. E., and A. H. Arthington. 2002. Basic principles and ecological consequences of altered flow regimes for aquatic biodiversity. Environmental Management 30:492-507.

Burghardt, K. T., D. W. Tallamy, and W. Gregory Shriver. 2009. Impact of native plants on bird and butterfly biodiversity in suburban landscapes. Conservation Biology 23:219-224.

Claeson, S. M., C. J. LeRoy, J. R. Barry, and K. A. Kuehn. 2014. Impacts of invasive riparian knotweed on litter decomposition, aquatic fungi, and macroinvertebrates. Biological Invasions 16:1531-1544.

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Reinhart, K. O., and R. VandeVoort. 2006. Effect of native and exotic leaf litter on macroinvertebrate communities and decomposition in a western Montana stream. Diversity and Distributions 12:776-781.

Sturman, P. J. et. al. 2008. Sulfur cycling in constructed wetlands. Pp. 329-344 *In* Constructed and Natural Wetlands, edited by J. Vymazal. Springer Science+Business Media, New York, New York, USA.

Tallamy, D. W. 2007. Bringing Nature Home. Timber Press, Portland, Oregon, USA.