Stream Health Assessment of Courtland Creek, Oakland California

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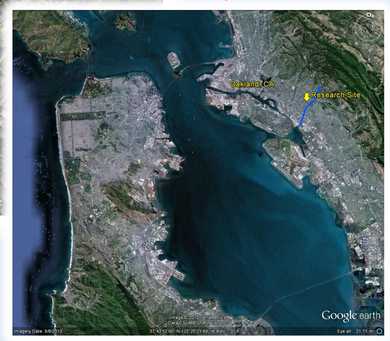
Introduction

Courtland Creek is an East-West trending stream located in the cities of Berkeley and Oakland, California (Figure 3). The water flows from the Oakland hills to the East Creek Slough where it enters the San Francisco Bay (Figure 4). Like many of the creeks in urban Oakland, development as altered the riparian habitat. The stream is culverted for much of its course and is exposed intermittently. We studied exposed sections paralleling Courtland Avenue between Thompson Street and Brookdale Avenue. Courtland Creek flows through a residential neighborhood with private properties extending to the upper reaches of banks in some sections and swaths of parkland in other portions. We set out to determine overall health of this stream using chemical and ecological assessment tools. We conducted dissolved oxygen, nitrate and benthic macroinvertebrate studies at three sites along Courtland Creek .

Benthic organisms have several characteristics that make them useful indicators of water quality. They are sensitive to physical and chemical changes in their habitat and so reflect conditions in the water throughout their aquatic stage of their life cycle. Fish, invertebrates, plants and aerobic bacteria all need oxygen to live. The amount of dissolved oxygen present in a stream will determine what species of invertebrates can survive in a stream. When the level of dissolved oxygen in the creek falls below 4 ppm, many fish and active invertebrates will choose to leave the area by swimming or crawling away. At 2 ppm the water is considered hypoxic, conditions become stressful for many benthic invertebrates. The natural level of ammonia or nitrate in surface water is typically low (less than 1 mg/L); in the effluent of waste water treatment plants, it can range up to 30 mg/L. High levels of nitrates can lead to hypoxia when aquatic plants that bloom under high nutrient conditions decompose.

Figure 3: Research Site Locations at Courtland Creek



Firgure 4: Research Site Location in SF Bay Area

Methods

We collected nitrate samples at each sample site on July 17th, 2012 using the Aquarium Pharmaceuticals (API) Nitrate Test Kit. The kit reads total nitrates in parts per million (ppm) which are equivalent to milligrams per liter (mg/l) from 0 – 160 ppm. We also collected dissolved oxygen samples on July 17th at each site and used a LaMotte Dissolved Water Quality Test Kit to determine concentrations. We collected samples for Benthic Macroinvertebrates on July 19th, 2012. We classified benthic macroinvertebrates into three groups based on their sensitivity to pollution. To collect samples we performed kick samples using a Surber net at Site 1- Courtland Avenue & Thompson Avenue, Site 2-Courtland Avenue between Tyrell Street and Congress Avenue & Site 3 – Courtland Avenue between Fairfax and Brookdale Avenue (Figure 3). To perform the kick samples we located a riffle and moved downstream to a flat area where the net can be submerged and good flow into the net can be achieved. We then placed the net across the flat area, and begin timing (1 minute sample time). For the first 30 seconds, we picked up rocks or cobble within a 1-foot square area in front of the net, and scrub with gloved hands to remove attached organisms. For the second 30 seconds, we dug the gloved hands into the substrate within the 1-foot square sample area in front of the net. At the end of the sample time, we removed the net from the creek, making sure to sweep the sample into the back of the net. We then carefully rinse the entire sample obtained from the kick sample into back of the net, then flipped the net inside-out and washed the sample into a white dish bin, using clean water from the creek. The sample was then rinsed into the bin where we analyzed the sample by pouring an aliquot of the pooled sample through a sieve placed in a white dish bin. We then removed organisms to a tray and identified them using a key. The number of taxa in each of the sensitivity groups were tallied and assigned a score. The scores were then summed to yield a score which was used as an estimate of the quality of life in Courtland Creek.

Results

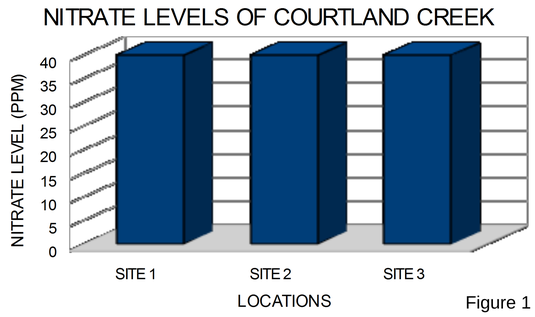


Figure 1

Figure 1 demonstrates that Courtland Creek has high levels of nitrates, 40 ppm, throughout all sites. This level would be toxic to vertebrates and stressfull for many invertebrates.

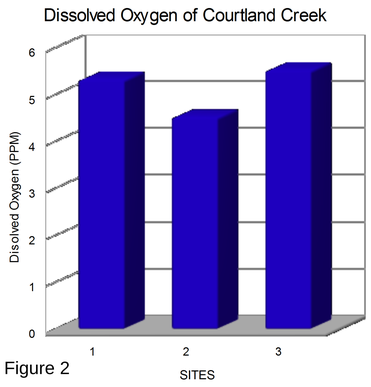


Figure 2

Figure 2 demonstrates that Courtland Creek's dissolved oxygen levels range from sufficient to stressful for most species.
Site 1 is 5.3ppm sufficient for most species.
Site 2 is 4.5ppm stressful to most aquatic species.
Site 3 is 5.5ppm sufficient for most species
Dissolved oxygen is lower than expected for a stream but is not the limiting factor for species in this creek. Site 2 shows a dissolved oxygen level of 4.5ppm, stressful to most species.

	Site 1	Site 2	Site 3
Number of Taxa Sensitive to Pollution	1	2	3
Number of Taxa Pollution-Intermediate	1	0	2
Number of Taxa Pollution-Insensitive	1	1	2

Table 1

Table 1 shows low numbers of taxa represented at each site. The sites did all contain mayfly larva which are classified as pollution sensitive group. The presence of these organisms indicates the conditions that the creek can support sensitive organisms. However, the numbers of individuals was very low with 5 being the highest number of mayflies collected at Site 1. Numbers of organisms were low for all taxa represented.

Site	Number of Taxa Pollution-Sensitive Index Value 3	Number of Taxa Pollution-Intermediate Index Value 2	Number of Taxa Pollution-Insensitive Index Value 1	Total Number of Taxa
1	1	2	3	6
2	1	0	2	3
3	1	1	2	4
Total x Index Value	3 x 3 = 9	3 x 2 = 6	7 x 1 = 7	13

Table 2

$$\frac{\text{Total Index Value}}{\text{Total Number of Taxa}} = 22/13 = 1.69$$

Table 2 categorizes benthic invertebrates according to their sensitivity to pollution and assigns a value according to group. Taxa sensitive to pollution are given an index value of 3, taxa with intermediate sensitivity are assigned a 2 and taxa insensitive to pollution are assigned a 1. The number of taxa in each category are multiplied by the index value and total index value is obtained. The total index value is divided by total taxa to gain an average pollution sensitivity rating. Courtland Creek Index Value averaged to 1.69

Discussion

Courtland Creek is a stream in poor health according to our findings. Nitrate levels are high and would be toxic to fish populations if they were present. Fertilizer and animal waste inputs close to streams can cause high levels of nitrates in streams. We noticed dog waste at Site 1 and Site 2 and 3 appeared to have human encampments along the creek. This human and animal presence may influence the levels of nitrates in the creek but further testing along other areas of the stream should be conducted. Data collected for Sausal and Peralta Creeks reveal expected 0 ppm for nitrate levels.

Dissolved oxygen is also low and will affect the population of invertebrates and vertebrates in the creek. Testing at Peralta Creek, in the same watershed and with comparable depth revealed dissolved oxygen to average at 7.5ppm using the same testing. Data should be collected for Courtland Creek throughout the year to determine seasonal fluctuations in dissolved oxygen.

This Biotic Index Value demonstrates that pollution insensitive and intermediate pollution sensitive organisms dominate Courtland Creek. However, so few organisms were collected that the application of this or any other Index Value is inappropriate. The small sample size does not provide enough evidence to make clear evaluations. The presence of pollution sensitive mayflies generally indicates a healthy freshwater ecosystem but the low amount of individuals may point to an unhealthy system. This biotic index value records presence of taxa and does not take into account population size. Benthic macroinvertebrates survey resulted in a poor rating for Courtland Creek. Numbers of individual invertebrates were low at each site as well as taxa present was low. At Sausal Creek, Oakland numbers for individual organisms are often counted in the hundreds, a recent survey counted more than 900 black flies. It may be that substrate conditions may be a limiting factor in this urban creek. Much of the creek is culverted and areas of riffles may be sparsely interspersed throughout the system. Further analysis of the substrate at each site should be conducted.
This initial assessment of Courtland Creek revealed an unhealthy system. Further data should be collected across the length of the creek and throughout the year to get a comprehensive understanding of the dynamics of this system. Restoration efforts by the Friends of Courtland Creek should be supported and expanded. The Friends of Sausal Creek has conducted extensive restoration and research in their watershed with great improvements in overall health of creeks in Oakland, California and serve as a model for community led stream improvement.

Research group presenting a restoration proposal to Oakland Public Works Department at Site 1 Courtland Creek.

Research group sorting through benthic macroinvertebrate sample.