Emily Lopez

8-6-09

Litzsinger Road Ecology Center

Deer Creek Water Monitoring Research Project

Deer Creek was studied at for its ability to support living organisms based on the condition of the water. The main question asked was how does Deer Creek's physical condition affect the quality of its water and its ability to support living organisms and maintain a healthy ecosystem? Three different monitoring spots were set up for analysis: two pools and another area downstream from a riffle. One of the pools was shaded most of the day while the other was sunny most of the day; these areas were picked specifically for their different conditions. Two sets of data were taken from each site on the monitoring days, once in the early morning and then again in the late afternoon. The tests were carried out over approximately a month's time, taking data about two to three days each week depending on the weather conditions. The values that were monitored at each site consisted of the start time at each site, dissolved oxygen (DO) levels at the surface and bottom, pH, air temperature, water temperature, turbidity, weather conditions, invertebrate and other organisms observed, and the amount of rainfall that had occurred in the past three days from the sampling day. Other observations were recorded such as the water level and flow, the condition of the creek bed, and the visibility of the water. The materials used consisted of a dissolved oxygen kit, an electronic pH meter, a turbidity tube, thermometers for both water and air, a rain gage, and a clock. The findings showed a great range in the dissolved oxygen levels from site to sit in both surface and bottom measurements, with 3 mg/L being the lowest and 13 mg/L being the highest. This shows that the amount of available oxygen for organisms living in the creek does vary. It was also found that the pH level did not have a very large range. With the pH values; the low was 6.5 and the high was 8.1. However, the pH of 6.5 was only collected on one afternoon monitoring at all three sites, but not in the morning monitoring. The pH and the DO were the two values that had the most interesting findings and presented the largest conclusions for this research project.

There are many different procedures and values involved with water chemistry and testing. Some of the more major ones that were measured in this study involved pH, dissolved oxygen, turbidity, and water temperature. A value of pH is a fairly common figure used in many different ways, not just water testing. The term pH is taken from the way in which the H+ ion concentration is calculated, it is actually the negative logarithm of the H+ ion concentration. With a high pH there are fewer free H+ ions and therefore a change in the pH level indicates a change in the concentration of H+ ions. The pH of water alternatively determines the solubility and biological availability of chemical elements and heavy metals. Through the pH value one can decide if aquatic life can readily use the nutrients in the water and, therefore, if the body of water can adequately support a large amount of aquatic life. With heavy metals, their solubility determines their toxicity to the aquatic life and the surrounding water. However, metals are said to be more toxic at a lower pH reading because they are much more soluble. Another element present in the water is carbon dioxide which is used up during photosynthesis. In water, CO_2 acts like carbonic acid, therefore when it is used up it reduces the acidity of the water, increasing the pH. In direct contrast to that, respiration of organic matter, in the water or on the waters surface, generates CO_2 which then dissolves in the water as carbonic acid, decreasing the pH. That is why pH will usually be higher in the daylight and during a growing season, when photosynthesis is taking place. Usually, within the summer months in a creek or stream, the pH will range between 7.5 and 8.5, however, according to the EPA, a pH of 5 to 6 or lower can be directly toxic to fish.

Dissolved oxygen on the other hand is something that is usually only measured in water, but it can be in deep or shallow water, and stagnant or flowing water. Dissolved oxygen or DO is measured in mg/L which indicates the mass of 0_2 per liter of solution. The oxygen content in water can be calculated by adding equal parts of magnesium and iodine ions in an alkaline solution to the sample of water. Finally titrate it against sodium thiosulfate with a starch indicator. This is called the Winkler test for dissolved oxygen. Dissolved oxygen can be affected by many different things, some naturally occurring, some not. Things naturally occurring are more so those that can not be changed. With that, season changes can affect DO. Warmer weather during the summer months can speed up the rate of photosynthesis and decomposition and increased temperatures causing decreased amounts of DO solubility. Also when large amounts of plants die off at the end of a growing season, their decomposition rates contribute to heavy oxygen uptake. Then the things that are not naturally occurring are affects like pollution. Pollution such as sewage and agricultural runoff causes a decrease in DO concentration. Besides dissolved oxygen there is also biochemical oxygen demand and chemical oxygen demand or BOD and COD. BOD is the rate of usage of oxygen by organisms in a body of water. BOD is not a completely accurate quantitative test; however, it is largely used as a water quality test. COD is used to determine the amount of organic compounds in water. It can also be used to measure the amount of organic pollutants in surface water which is also a direct analysis of water quality.

Water temperature is another factor that can determine water quality in many different ways. When it comes to evaluating the health of the organisms that live in a water system temperature can really play a role. The rate of chemical reactions in the water increases at higher temperatures, which directly affects biological activity. The higher the water temperature is, the greater the rate of biological activity. Many aquatic species such as; fish, aquatic insects, zooplankton, and many others have preferred temperature ranges. Within those preferred temperatures, a number of different reactions can occur. Warmer water temperatures increase the solubility of salts but can decrease the solubility of gases. Warmer water can hold less oxygen; therefore, less dissolved oxygen is available for the organisms in the water. Water may be saturated with oxygen, but not actually have enough to support aquatic invertebrates or certain species of fish for the duration of their life cycle. Also certain naturally occurring compounds in the water can become toxic to aquatic life at increased temperatures. How creeks and streams receive higher temperature water is another factor. Thermal pollution, or artificially higher water temperatures, can occur from discharge of municipal or industrial effluents. Also, runoff from hot asphalt or concrete can be heated, causing a large warming affect in the stream. In smaller urban creeks that have large periods of low to no flow the runoff from roads or parking lots can be a serious problem for species of cold water fish.

The materials that were used consisted of a dissolved oxygen kit, an electronic pH meter, a turbidity tube, thermometers for both water and air, a rain gage, and a clock. The dissolved oxygen kit contained three different chemical compounds that were added to the water sample in a distinct step wise order to determine the DO concentration. Three monitoring spots were set up for analysis; two pools and another area downstream from a riffle. One of the pools was shaded most of the day and a little more narrow and shallow, while the other was sunny most of the day, deeper, and wider. These areas were picked specifically for their differences in conditions and how that would affect the values that were tested there. Two sets of data were taken from each site on the monitoring days, once in the early morning and then again in the late afternoon. This was done because dissolved oxygen and other values can shift dramatically from night to day and therefore start to change as soon as the sun rises. With the morning samples the testing started, downstream from the riffle, then on to the sunny pool and finally the shaded pool. During the afternoon testing, the sampling began at the third site, the shaded pool, and then the sunny pool and finally ended with the site downstream from the riffle. The tests were carried out over approximately a month's time, taking data about 2-3 days each week depending on the weather conditions. However, if weather conditions started to turn during the sampling period, such as rain, the sampling was still completely finished. The values that were monitored at each site consisted of the start time at each site, dissolved oxygen levels at the surface and bottom levels, pH, air temperature, water temperature, turbidity, weather conditions, invertebrate and other organisms observed, and the amount of rainfall that had occurred in the past three days from the sampling day. The rain data was collected from the rain gage on site. Other observations were recorded such as the water level and flow, condition of erosion on the creek bed, visibility of the bedrock, and visibility in the water. For the dissolved oxygen levels; only surface values were taken at the site downstream from the riffle, while surface and bottom values were taken at the pools.

With all the data that was collected different comparisons of the values were made. The main value that was studied was dissolved oxygen, which was graphed up against pH. There were three outlier pH values of 6.5 which did match up with two DO values close together and another much higher. There were many DO and pH values that fell in the mid range with numbers between 7.6 and 7.8 and DO readings of 6 to 8. While sites 1 and 2 had farther outliers on pH and DO than site 3 they also had the highest DO values. This could be due to the amount of sunlight the areas get throughout the afternoon up until the testing time of about 2 to 3 o'clock. The highest DO values line up with some of the highest pH values throughout the sites and site 3 had the highest pH values. Dissolved oxygen was graphed with morning and afternoon values compared, however, only at the surface. Site 3, the shaded pool, had quite a range from morning to afternoon monitoring. Site 2, the sunny pool, had less of a range between morning and afternoon, but much higher readings all together. Site 1, downstream from the riffle, had a great range and higher values of DO. Sites 2 and 3 seemed to have similar values all together because they were both pools rather than shallow riffle areas. Site 3 seemed to have low values in the morning and higher in the afternoon; this was directly due to the amount of daylight there. Site 2 had high values in the morning and afternoon while site 3 had mid level values in the morning and afternoon. Dissolved oxygen was also graphed with surface against bottom values by sites of sunny and shaded. The sunny pool had high bottom and surface DO, while the shaded pool had a range of values in surface and bottom levels. Many of the values from both bottom and surface from both pools were similar, as well as, within each monitoring spot. This occurred with both sunny and shady pools. The final graph that was done was pH against the water temperature values, looking at the morning and afternoon sampling. Most of the pH levels fell in the 7.4 to 8 range with three outliers at 6.5. These three outliers were taken at each site in the afternoon and were the lowest of the pH values. This could have been from different compounds present in the water; the temperature seemed to have a difference between those sites along with the DO. The afternoon water temperatures were higher than the morning numbers, except for a few in the 22˚ C – 24˚ C range. The highest pH value was 8.1, evaluated in the afternoon on two separate days, both at the shaded pool with similar water temperatures of 25˚ C and 26˚ C.

Most of the turbidity readings found were less than 10 at every monitoring spot, each day, except for ten of them. These ten values, in calculated order were: 11, 10, 10,10,11,13,13,13,10, and 13. The turbidity readings that hit 10 and 11 were early on in the testing period over three different days, following approximately 1 to 3 inches of rain (in the past 3 days from the monitoring day). The four turbidity readings of 13 were on two different days and after a period of approximately 3 to 3.5 inches of rain (in the past 3 days from the monitoring day). On all of these monitoring days the water level was up from the usual height.

All together the findings showed that the three sites did show many differences in the DO, pH, and temperatures values. The DO and pH values seemed to change in similar patterns. However, the pH values didn't have as much of a range as the DO. This does say that Deer Creek has a fairly constant pH that is within normal runoff water limits for pH. Air temperatures and water temperatures changed directly with the time of day in which they were measured and the amount of sunlight that the area testing was receiving. Rainfall did play a role in some of the values tested; DO, water temperature and turbidity on some days, especially when the water level was visibly higher than normal. However, the pH did not show a direct change with the amount of rainfall recorded in the three days before testing.

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