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Kinderhook Creek Bioassessment
Fall 2004

Background

Mr. Kleyman's Stream Ecology class from Darrow School collected two sets of evaluations of the Kinderhook Creek in New Lebanon, NY in October of 2004. The Kinderhook Creek has been identified as a Class C trout spawning stream. Its main uses include fishing, trout spawning, and limited contact recreation. The Kinderhook Creek is located off of Adams Crossing Road in New Lebanon. The majority of surrounding land is pastures and farmland, but the farms are not located directly next to the creek. The elevation is approximately 100 feet above sea level (Adler S).

The main purpose of our assessments was to determine the health of the stream. We wanted to make sure that the stream was meeting the NYS DEC water quality standards for a Class C trout spawning stream. On our trips into the field we performed a variety of water quality tests including: pH, temperature, turbidity, alkalinity, phosphates, nitrates, and dissolved oxygen. In addition to chemical testing we completed a physical evaluation of the creek and its immediate surroundings. We also performed a biological assessment in which fecal coliform levels were assessed and benthic macroinvertebrates were gathered and categorized for study (Wielga N).

Physical Assessment

A physical survey is used for background information to help design a monitoring program. This survey should be done at least once a year. When picking an area to survey, it should be a segment approximately 200 feet. In this survey, describe the site location thoroughly. The elements that are observed and tested are temperature, width, depth, velocity, relative flow, sediment deposits, water odor, water appearance, algal growth, and other surroundings that affect the water (DeMarco J).

The class conducted a detailed physical assessment of the Kinderhook Creek. Components of the physical assessment included: channel, habitat, and stream bank characteristics. In the channel characteristics section the average water temperature as 9.5° Celsius and the average air temperature as 4.4° Celsius. The average width of the stream was 14.6304 meters, and the average depth was .346 meters. The average velocity of the Kinderhook Creek was 3.33 feet per second, and the relative flow was high. The only sediment deposit observed was sand. The water had no odor, was yellow to dark brown ("tea-colored") which occurs naturally from dead leaves decaying in the stream, and from streams draining wetlands. We noted that there was an algal growth of approximately 0-25%. The river is neither straightened nor channelized, and has a concrete bridge crossing over downstream of our testing site. We noticed moderate current, producing small riffles. The stream shading was less than 25%, and the known recreational uses include fishing and swimming. In the habitat characteristics section we noted the substrate composition. The stream contained approximately 0% bedrock, 25% boulders, 45% rubble, 15% gravel, 10% organic debris, and 5% silt. The Kinderhook Creek has 5-25%

embeddedness, and 5-25% overhead canopy. In the stream bank characteristics category we noted distinctive qualities pertaining to the left and right portions of the stream bank. On the left side we observed 50% shrubs, 30% grass, and 20% hardwood/other trees. On the right bank we observed 60% shrubs, 20% grass, 5% gravel, and 15% hardwood/other trees. The setting of the Kinderhook Creek is characterized by a wooded area with roads and scattered residential developments. Less dominant were road-less wooded areas, cropland, and grazed pasture.

In addition, we noted possible sources of pollution in the Kinderhook Creek watershed. There are seven gravel pits within the watershed that create the possibility for runoff into the creek. There is a landing strip located uphill from the Kinderhook Creek that may cause pollution as well. Roads are a big source of pollution because spilled gasoline and other chemicals can wash off the road and into the stream. The Kinderhook Creek crosses various roads four times, as well as railroads, which are crossed twice. Within the general area there is one horse farm and various farm fields. Animal manure and pesticides from these farms may runoff into the stream and cause serious harm. In addition, there are two swamps running into the Kinderhook Creek watershed. All of these are examples of non point source pollution (Adler S).

Chemical Assessment

During our testing periods at Kinderhook Creek, our class did a thorough chemical assessment. This was tested over the course of 2 days, October 5, 2004 and October 19, 2004. For each test we did independent replicates on each day. The testes included alkalinity, dissolved oxygen, nitrates, pH, phosphates, temperature and turbidity (Wielga N).

Alkalinity

Alkalinity is a measure of the capacity of water to neutralize (or buffer) acids. It is important to test because a river where acid is added might have a change in pH without acid - neutralizing capacity.

The test we used was the LaMotte Alkalinity code 4491-DR model WAT - DR. There are no New York State DEC standards for a Class C (TS) stream. The average result Kinderhook Creek received was 41ppm and meets state standards(Bookbinder J) .

Dissolved Oxygen

Dissolved oxygen is the amount of dissolved oxygen gas in the water. Our class average was 3 mg/l. Dissolved oxygen is necessary for any aquatic and plant life to survive and reproduce in the stream. The specific levels of dissolved oxygen determine what plant and aquatic life are able to survive and reproduce in the stream.

We used a LaMotte Dissolved Oxygen Kit code number 5860. The New York State DEC standard for dissolved oxygen in class C (TS) streams should be no less than 7 parts per million. Kinderhook Creek has 3 parts per million, which is lower than the state standard (Marquis C).

Nitrates

Nitrate is the form of nitrogen that is a necessary nutrient for plants and animals to make proteins, and it is found in terrestrial and aquatic systems. Some examples are nitrates, nitrites, and ammonium. Excessive amounts of nitrates cause a great increase in plant photosynthesis and growth. It affects the health of numerous aquatic organisms, as well as humans. Combined with phosphorous, nitrates accelerate eutrophication. This indirectly affects other water quality indicators such as dissolved oxygen and temperature. Large amount of nitrates can make the water become toxic for humans to drink.

We used the LaMotte Nitrate- Nitrogen code 4408 model VM-12 test kit. The New York State DEC standard for nitrates is, “None in the amount that will result in algae, weeds, or slime that will impair the water for its best uses.” Kinderhook Creek received a 0 ppm and meets the state standards (Adler S).

PH

PH is a measure of the acidity in a solution. It is critical to an aquatic ecosystem because pH affects many chemical and biological processes in water. Changes in pH can have a large impact on aquatic organisms (Carroll C).

We tested for pH the LaMotte Wide Range pH test model P-3100 and code 2117. The New York State DEC standards for pH level in class C (TS) streams are no higher than 8.5 and no lower than 6.5 on the pH scale. The Kinderhook Creek has a pH of 7.5 and is within the limits of the New York state DEC standard (DeMarco J).

Phosphates

Phosphorous is a vital nutrient for plant growth, photosynthesis, and other metabolic reactions occurring in plant and animal life. In a healthy stream phosphate levels tend to stay low and balanced. High levels can be caused by agricultural drainage wastewater, runoff, and other forms of soil disturbance. The increase in various nutrient levels cause eutrophication. As the algae steadily depletes the dissolved oxygen levels in the water, causing algae to die, and sink to the bottom of the stream, awaiting decomposition. Microorganisms that decompose reduce the dissolved oxygen, in turn; the low levels of dissolved oxygen can hinder the growth and development of aquatic organisms and wildlife, such as fish. If phosphate levels increase dramatically, a fish kill is probable.

We use the LaMotte Low Range Phosphates model VM-12 code 4408. For a class C (TS) streams the New York State DEC standard is, “no amounts that will result in algae growth, weeds, ands slime that will impair the water for its best usages.” The Kinderhook Creek received1 ppm and meets the state standards (Adler S).

Temperature

It is important to test for temperature because temperature can affect the amount of oxygen in the water (cooler water has a higher oxygen level), the rate of photosynthesis of aquatic plants, the metabolic rates of aquatic organisms, the rate of decomposition, and the sensitivity of organisms to toxic wastes, parasites, and disease. Trout spawning depends on a certain temperature range as do other aquatic organisms. Benthic macroinvertebrates are especially sensitive to the water temperature.

We tested the temperature of Kinderhook Creek using an environmentally safe thermometer. The New York State DEC standards for class C (TS) streams is no temperature greater that 21.1 ° Celsius. The Kinderhook Creek tested at an average of 9° Celsius and is within the state standards (St. John S).

Turbidity

Turbidity is the measure of the cloudiness of the water. Turbidity is tested because it can increase the temperature, which reduces the level of dissolved oxygen. Drinking water is tested for turbidity because elevated amounts of turbidity can cause a breeding ground for microorganisms.

We used the LaMotte Turbidity test model 2117 when testing the turbidity of Kinderhook Creek. Our results showed that Kinderhook Creek received a 7.5 JTU. New York State DEC standards say there should be “no increase that will cause a substantial visible contrast to natural conditions.” Since the creek is clear, then the level of turbidity is acceptable for the New York State DEC standard (Wielga, N).

Biological Assessment

Benthic Macroinvertebrates

Benthic macroinvertebrates are animals without backbones that are larger than .5 millimeters (Mullen, Beth). They are an essential part of the food chain, acting as a food source for many types of fish. Due to their abundance, benthics play an important role in the natural flow of energy and nutrients. Benthics are not very mobile and tend to stay in the same area. Because of this, they can provide reliable, consistent information regarding the water quality of a stream. They typically have long life spans, enabling researchers to determine any decline in the environmental quality of a stream or watershed. In addition, due to their long lives, aquatic ecologists are able to detect major pollution in the past, such as pesticide spills and illegal dumping. Benthic macroinvertebrates represent a large, diverse group of aquatic wildlife. The large quantity of species possesses a wide variety of responses to factors that affect water quality such as organic pollutants, sediments, and toxicants. When using benthics to examine water quality, the following characteristics of the sample are very important indicators used to determine the stream health. Taxa richness is a measure of the number of different types of benthics. A greater taxa richness typically indicates better water quality. Benthics (especially mayflies, stoneflies, and caddisflies) are sensitive to pollutants such as heavy metals and organic wastes. If a large sample of these benthics are collected in a stream, the water quality is

most likely very good. The only two types of benthics that can tolerate pollution are non-biting midges and worms. If these are the only species present, the water is most likely polluted. The presence (or absence) of certain feeding groups, such as scrapers and filterers, may indicate a disorder in the benthics' food supply, and possibly the effects of toxic chemicals.

When testing for benthic macroinvertebrates it is important to test in two areas with high flow, and two areas with low flow. This is to make sure the sample gathered is representative of the entire stream habitat. It is essential that the first sample is gathered downstream, so as not disturb benthics inhabiting the sediments. In the lab, the sample is separated according to Tier 3 standards, by family, and preserved in alcohol.

There are many ways to summarize and interpret benthic macroinvertebrate habitat data. Total Family Richness is the total number of macro invertebrate families represented in the sample. The sample from the Kinderhook Creek had a total family richness of 11. A total family richness of 10-13 is considered slightly impacted. According to total family richness, the Kinderhook Creek is slightly impacted.

EPT Family Richness is the number of mayfly, stonefly, and caddisfly families in the sample. The orders of Ephemerotera, Plecoptera, and Trichoptera contain numerous taxa. They are very sensitive to fluctuations in the water quality. It is calculated by adding the number of mayfly, stonefly, and caddisfly families found and classified. Typically, the more EPT families means better quality and a better habitat. In certain areas (such as pristine headwater streams) an increase in richness may be an indicator organic material pollution, such as from a septic system. The EPT richness in the Kinderhook Creek was 9, and a non impacted stream has an EPT richness of greater than seven. So in this aspect, the stream is considered non-impacted.

Biotic Index is an analysis developed to summarize various pollution tolerances of families that make up "the aquatic insect community," (Hilsenhoff). To calculate the biotic index:

1) Determine the pollution tolerance values for each family
2) For each Family, calculate the following: average density for each Family times the pollution tolerance value for each family
3) Add the results for all the families and divide this by the total average density. The result is the biotic index (Geoff Dates & Jack Byrne).

The family biotic index of the Kinderhook Creek is 3.38. According to NYS DEC standards a family biotic index of 0-4.50 is considered non-impacted. According to family biotic index, the Kinderhook Creek is non-impacted.

The percent model affinity is "a measure of the similarity of the Percent Composition of Selected Major Groups of your sample to that of a model "non-impacted" community" (Geoff Dates, Jack Byrne). To determine the percent model affinity, the following steps must be completed. First you must determine the percent of the sample that falls into each of the 7 major groups. For each of the groups, find the difference between the model community and data obtained from your sample, and add all of the differences together. Next, multiply the final

sum by .5, and subtract this number from 100, and the final number is percent model affinity. The percent model affinity of the Kinderhook Creek is 60. The NYS DEC standards for a slightly-impacted stream are 50-64. Therefore the Kinderhook Creek is considered non impacted.

BMI's in KC 10/19/04			
Mayfly (Ephemeroptera)			True Flies (Diptera)
flathead	brushlegged	Small Minrow	Midge
Heptageniide-31	Isonyehiidae-22	Baetidae-7	Chironomidae-1
Stonefly (Plecoptera)			Beatles (Coleoptera)
Predator	Shredder		Riffle Beetles
Perlidae-6	Pteronarcydae-1		Elmidae-4
Caddisfly (Trichoptera)			
Common Netspinner	Casebuilder	Free Living	netspinner
Hyaropsychidae-15	Brachycentridae-7	Phyacophildae-2	Polycentripodidae-4

Fecal Coliform

Significance

Fecal coliforms are types of bacteria found in the digestive systems of animals and wildlife, which come from fecal matter. The actual coliforms generally are not harmful to humans, but they can be an indicator of other disease causing bacteria such as Typhoid, Hepatitis A, and Cholera. Fecal coliforms and other disease causing bacteria survive well in streams, a water source and habitat for many species of wildlife. If a person were to eat an animal that had used a contaminated stream as a water source, he or she might suffer from mild to severe food poisoning, or even cholera. Fecal coliform levels can be affected by sewage contamination, precipitation, and runoff.

Method

Fecal colifom is measured by pink and white colonies within a Petri dish, while E.coli bacteria have a purple tinge. The first step is to label two Petri dishes, one for E.coli and one for fecal coliform. The next step is to collect stream water in a sterile sample container. Transfer the sample water into the Coliscan Easygel bottle, and swirl the water until the gel is thoroughly dissolved, and pour the solution into the Petri dishes. Place the Petri dishes in an incubator for 24 hours at 95 degrees Fahrenheit. After time has passed, remove the Petri dishes from the incubator and observe. Count all of the purple colonies,

disregarding all other colors. Report results in the unit coliforms per mL of water. Divide 100 into the mL of solution uses, and then multiply the count in the plate by the number of colonies found in the Petri dish. Next, count all of the pink colonies, disregarding all other colors, record data, and plug numbers into standard equation.

Results

On October 19th, 2004 the recorded levels of fecal coliform were 270 coliforms per 100 mL of water. Our data is incomparable because it does not meet standards.

Standard

The standard for fecal coliform is: should not exceed 200 fecal coliforms per 100 mL of water. In addition for data do be analyzed, information needs to be recorded five times in 30 days, and the average of the five numbers is taken (Bookbinder J, Drake J).

Summary of Results and Conclusions

Summary of Results:

Physical Parameters:

- All aspects of the physical assessment seem normal; no visible algal growth or residue from chemicals/pesticides on the surface of the water.
- The water temperature is consistent with the standards for its ideal usage. The New York state DEC standard for a class C (TS) is 21˚Celsius.
- The embeddedness of rubble is constant with the NYS DEC standards for a Class C (TS) stream. The New York state DEC standard for a class C (TS) stream is 5%-25%.

Chemical Parameters:

- The phosphate levels are within the standards for a class C (TS) stream.
- The monitored dissolved oxygen levels are below the standards for a Class C trout spawning stream and may be toxic to the aquatic life. The DEC standard for the state of New York is less then 7 ppm. Our test results was 3 ppm.
- The pH and alkalinity meet the proposed standards for a Class C stream trout spawning stream.
- The nitrate levels are consistent and meet the desired standards for a Class C stream trout spawning stream.
- The temperature and turbidity are at the desired levels for a Class C trout spawning stream (Class Handout).

Biological Parameters:

- The standard for fecal coliform bacteria is 200 colonies of fecal coliform bacteria per 100 mL of water but the results are an average of testing 5

times in 30 days. We cannot compare our results to standards. Our test result was 270 colonies of fecal coliform bacteria per 100 mL of water.

- The EPT richness in the Kinderhook Creek was 9, and a non impacted stream has an EPT richness of greater than seven. The Family Biotic Index standard for a class C (TS) stream is less then 4.50. Our class measured a level of 3.38. So in this aspect, the stream is considered non-impacted.
- Percent Model Affinity and Total Family Richness show that the stream may be slightly impacted. The result for Percent Model Affinity was 60% and the result for Total Family Richness was 11.
- The Family Biological Profile shows a non-impacted stream (Adler S).

Conclusions:

- The fact that there is a greater amount of fecal coliform indicator bacteria and a lesser amount of dissolved oxygen shows that something is impacted.
- The increase in fecal coliform and decrease in dissolved oxygen could potentially impair the Kinderhook Creek for its best usages.
- Fecal coliform level is 270 colonies of fecal coliform bacteria per 100 mL of water and the DEC standard for NY States is 200. Fecal coliform colonies per 100 mL of water. This level is higher and may indicate something but this value cannot be compared to the standard because our class did not test 5 times in the 30 days.
- Benthic macro invertebrates were analyzed by Mr. Kleyman's stream ecology class with the hope that we could determine any decline or improvement in the water quality of the Kinderhook Creek. When using benthic macro invertebrates as a tool to examine water quality, the following characteristics of the sample are very important indicators.
- Fecal coliform indicates organic waste which is broken down by critters and bacteria that use oxygen. Organic waste has nitrogen; an increase in nitrogen enables algae and plants to grow. When the plant life dies off, decomposers decompose the plants and use dissolved oxygen possible a link between dissolved oxygen and fecal coliform.
- Dissolved oxygen has a DEC standard of 7 ppm. and anything below 7 ppm. is considered very toxic. Our class C (TS) stream had an average dissolved oxygen of 3 ppm. In doing so we might not see the pteronarcyidae that we found when collecting. This benthic macro invertebrate could not survive in such low dissolved oxygen.
- Based on the physical analysis we can assume that the Kinderhook Creek is a non-impacted stream.
- According to the chemical standards, the Kinderhook Creek is a slightly impacted stream. The slight impact comes from the decrease in the levels of dissolved oxygen.
- According to the biological parameters, the Kinderhook Creek is a slightly impacted stream. Benthic data levels generally indicated a non impacted

stream, while the fecal coliform levels indicated an impacted stream ecosystem.

- The decreased dissolved oxygen levels are not consistent with the NYS DEC standards for a Class C trout spawning stream, meaning that the water may be impaired for its best uses (trout spawning, fishing, and limited contact recreation).
- In our results, the benthic macro invertebrates and dissolved oxygen show that there may be some spurious data (Adler S, DeMarco J, Kleyman J, Marquis C).

Suggestions

1. Educate residents within the Kinderhook Creek watershed with information regarding the following aspects (Adler S).
   -What is going on in the stream?
   -How to avoid polluting the water?
   -What they can do to help?

2. Since the Kinderhook Creek does not comply with the NYS DEC standards for a Class C trout spawning stream, our class would propose more testing and monitoring a greater area of the stream throughout the year to attempt to specifically locate the source of the problems (Carroll C).

3. Our class may have encountered a small problem with measuring the level of dissolved oxygen in the Kinderhook Creek. Although the level of dissolved oxygen was below standards for a Class C (TS) stream, the collection and classification of our benthic macroinvertebrates tell us that there are some BMI's which would not have been able to survive with the level of dissolved oxygen we measured.

   Our class would suggest that the Kinderhook Creek be re-tested for dissolved oxygen to have more accurate results. We suggest doing a chemical test with one replicate, and also using a dissolved oxygen probe to more precisely measure levels (Carroll C).

4. In order to get an accurate result of fecal coliform, our class would suggest testing for fecal coliform five times within a thirty day period, because that is how the NYS DEC standard states fecal coliform should be tested (Carroll C).

5. Our class suggests that we re-collect benthic macroinvertebrates and re-classify them to provide another replicate (Carroll C).

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