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Stream Ecology
Lab Assessment:
The Kinderhook Creek

BACKGROUND

Ms. Janke's Stream Ecology class from the Darrow School conducted two sets of assessments on the Kinderhook Creek in New Lebanon, NY in September and October of 2003. The Kinderhook Creek is a Class C creek, for and its main purpose is trout spawning. It is located off of a road, (there is a bridge that goes right over it) and it is also surrounded by pastureland and farmland but there is a reasonably sized buffer between these lands and the creek itself. The purpose of the assessments was to determine the overall health and water quality of the creek and to see if the creek was meeting New York state water quality standards. During the first visit to the site, no samples were taken but physical assessment was taken in which we as a class looked at the physical condition of the creek and took down data regarding what we found. The second time we visited the creek, we were split up into groups that did a chemical assessment of the creek. We tested pH, turbidity, alkalinity, phosphates, nitrates, temperature, and dissolved oxygen levels. Finally, a biological assessment was also taken, in which fecal coliform levels were measured and benthic macroinvertebrates were collected and categorized for study.

PHYSICAL ASSESSMENT

Our class did an extensive physical assessment of the Kinderhook Creek. A large amount of data was recorded and sketches of the creek were also made. The class measured channel characteristics, habitat characteristics, and streambank characteristics. In the channel characteristics category, we noted that the average water temperature was 17 degrees celcius, the air temperature 19 degrees celcius, the average width of the creek 45 feet 7 inches, and the average depth 2 feet 7 inches. The average velocity of the creek was about 2 feet per second, and the relative flow was average. The only noted sediment deposits was sand, and the water really had no odor to note. The appearance of the water was clear for the most part with a hint of tea. The percent of the bottom of the stream covered in slight algal growth was about 75%. The river is channelized and straightened by the bridge covering it, because the bridge is a concrete wall. There is no upstream dam, no upstream wastewater treatment plants, and no visible pipes emptying into the river. In the habitat characteristics category, the substrate composition was about 75% gravel, 20% sand, and 5% silt. The creek has from between 25 to 50% embeddedness, and the overhead canopy is between 50 and 75%. As for streambank characteristics, the left bank (facing upstream) is about 25% grass, 50% hardwood, and 25% shrubs. The right bank (facing upstream) is about 25% shrubs, 25% grass, and 25% hardwood as well. The setting of the creek is characterized by a wooded area with roads, grazed pastureland, ungrazed meadowland, and less dominantly, a dairy farm, a park area, and scattered residential areas.

CHEMICAL ASSESSMENT

Along with a physical and biological assessment, our stream ecology class also did an extensive chemical assessment of the Kinderhook Creek. At the creek, we tested for pH, turbidity, alkalinity, phosphates, nitrates, temperature, and dissolved oxygen levels. Some interesting results were found.

pH

We tested for pH using two different methods. We first used the LaMotte Wide Range pH Test Kit and then used pH Testr2 probe to check the accuracy of the first test. The New York State DEC standards for pH level in Class C (trout spawning) waters is between the pH's of 6.5 to 8.5. *The Kinderhook Creek tested at a pH of 7, which fits the standards for New York state.*

It is important to test for pH in bodies of water is because pH is a measure of the acidity in a solution, and the level of acidity in the water affects both chemical and biological processes, and there is a certain pH range that water must maintain in order to provide an optimal ecosystem for aquatic organisms to flourish. Different organisms have different ranges of pH in which they survive best.

Turbidity

We tested for turbidity using the LaMotte Turbidity Test. The New York State DEC standards for turbidity in Class C (trout spawning waters) is "No increase that will cause a substantial visible contrast to natural conditions." *The Kinderhook Creek tested at .5 JTU, which fits the standards for New York state.*

It's important to test for turbidity because elevated levels of turbidity can affect an aquatic ecosystem in a number of ways. Turbidity can cause higher water temperatures, which in turn can reduce the level of dissolved oxygen in the water. It can also reduce the level of oxygen in the water by making the water less penetrable by the sunlight, which reduces photosynthesis. Suspended materials in the water can also clog fish gills, reduce fish's resistance to disease, lower growth rates, and effect egg and larval development. Also, turbidity can create a breeding ground for harmful microorganisms, which is a concern for drinking water.

Phosphates

We tested for phosphates in the Kinderhook using the LaMotte Phosphate Test Kit. The New York State DEC standards for phosphate levels in Class C (trout spawning) waters is "none that will result in growths of algae, weeds, and slime that will impair uses." There is no numerical standard, but between at .05 mg/L, an impact is likely and at .1 mg/L, an impact is certain. *The Kinderhook Creek tested at 0 mg/L of phosphates which is within the state standards.*

Phosphates are important to test for because when they are in short supply (which they can tend to be), they limit the growth of aquatic plants. However, too many phosphates can cause great increases in plant growth, or algal bloom. Too much algal bloom can result in lower levels of dissolved oxygen in the water, and a huge increase in the growth rate of aquatic vegetation can cause the river or stream to become clogged and

choked with weeds and plants. Phosphates also cause eutrophication because of the sudden increase of nutrients into the water. However, unless phosphates are present in extremely high concentrations, they generally do not pose a risk to humans or animals. Phosphates are not regulated in our drinking water.

Nitrates

We tested for nitrates using the LaMotte Nitrate-Nitrogen Test Kit. The New York State DEC standards for a Class C (trout spawning) body of water are "None that will result in growths of algae, weeds, and slime that will impair uses." As with phosphates, no numerical standard is given, but natural levels are generally less than 1 mg/L. *The Kinderhook Creek tested at 0 mg/L of nitrates which is within the New York state standards.*

It is important to test for nitrates for many of the same reasons that it is important to test for phosphates. A large amount of nitrates in the water can cause the process of eutrophication to speed up, which causes great increases in aquatic vegetation growth and changes in the types of plants and animals that live in the river. This also negatively affects dissolved oxygen levels, temperature, and other indicators of the river's health. Unlike phosphates, too many nitrates in the water can become a health hazard to both the aquatic organisms and to humans. Too many nitrates can cause low levels of dissolved oxygen in the blood of warm-blooded animals, can cause the water to become toxic to humans and other animals for drinking, can cause blood poisoning in babies, hypertension in children, gastric cancer in adults, and fetal malformations.

Temperature

We tested for the temperature of the Kinderhook using a regular thermometer. The New York State DEC standards for Class C (trout spawning) bodies of water actually doesn't exist, but the general guidelines for a healthy stream that supports trout is less than or equal to 21.1 degrees C. *The Kinderhook Creek tested in at 17 degrees C, which is within the New York state standards.*

It is important to test for temperature in the water because temperature affects the oxygen content of the water (cooler water has more dissolved oxygen), 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 diseases. In addition, every aquatic organisms has a range of temperature that is optimal for it to flourish in. Spawning also depends greatly on temperature, as each species has its preferred temperature range for spawning. Newly hatched embryos are also dependent on having a certain temperature range. Fish migration is also often triggered by temperature change. Finally, benthic macroinvertebrates are also very sensitive to temperature.

BIOLOGICAL ASSESMENT

Benthic Macroinvertebrates

It is important to collect information on benthic macroinvertebrates for several key reasons. First of all, benthic macroinvertebrates are "living barometers"; they have the ability to inform us about the condition of the stream that they live in. They have the ability to detect episodic events such as chemical spills or toxic dumping as well as the ability to detect cumulative pollution from non-point sources. Contaminants of a stream can cause many species to die out, allowing more tolerant species to survive and flourish, throwing off the whole balance of the stream. Moderate to severe pollution in a stream or river changes the benthic macroinvertebrate population drastically, so it becomes easy to assess the health of the stream and the condition of the water based on this. If a sample of benthic macroinvertebrates consists only of pollution tolerant species, then there is clearly a problem and the stream is impacted in some way. It is also possible to study other elements of the condition of the stream using benthic macroinvertebrates. Sedimentation is one of these elements. Most benthic macroinvertebrates live in the small spaces between pebbles and rocks on the stream bed. When sedimentation occurs, sediments and silt settle into these cracks and spaces and destroy the living spaces of these organisms, and this causes the population to drop. Benthic macroinvertebrates are an ideal species to study because they have limited movement and can therefore almost pinpoint the source of pollution if one exists. They also have relatively short life cycles, which allows the date at which the pollution started to be easily figured out.

Procedure

The procedure used to collect macroinvertebrates from the Kinderhook Creek involved using one replicate of the kick-net method of collection and then sorting out one-hundred samples to be preserved in alcohol and studied later. We sorted the benthic macroinvertebrates first into order groups and then into family groups using microscopes and entomology guides. Once separated into family groups , we collaborated and put our data together to get our final data set.

Data

**Please see attached appendix to view the actual tables of the data we collected.

We tested for organism density per sample, EPT family richness, total taxa richness, EPT/EPT + Chironomidae, biotic index, percent contribution of dominant family, percent model affinity, and percent composition of major groups.

Organism Density/Per Sample

Organism Density Per Sample is an estimate of the total number of individuals in the sample based on the number of organisms picked from a certain number of squares.

Density varies greatly from stream to stream, and it is best to compare results with a specific reference site. In general, however, density will increase with the addition of organic matter and/or improvements in the habitat conditions of the stream. *The Kinderhook Creek tested in at 400 units, which is healthy for a stream.*

EPT Richness

EPT richness is the number of mayfly (E), stonefly (P), and caddisfly (T) families in the sample. These particular species are sensitive to water quality changes. As a general rule, the more EPT families, the better the health or water quality of the stream is. The New York state standard for non-impacted streams is an EPT richness of greater than 7. *We collected 17 different families at our site, which shows that the Kinderhook Creek is a non-impacted body of water.*

Total Taxa Richness

Total taxa richness is the total number of families collected in the sample, not just the mayflies, stoneflies, and caddisflies. It is a rough measure of the diversity of the community in the stream. The results usually look similar to the EPT richness test. The New York state standard for non-impacted streams is a total taxa richness of greater than 12 different families. *We collected 27 different families at our site, which shows that the Kinderhook Creek is a non-impacted body of water*.

EPT/EPT + Chironomidae

EPT/EPT + Chironomidae is a measure of the ratio of the abundance of the EPT orders that are intolerant to pollution to the generally tolerant Diptera family Chironomidae. EPT/EPT + C is calculated by dividing the number of organisms from the mayfly, stonefly, and caddisfly orders by the above plus the number of Chironomidae order organisms in the sample. The results lie in between 0 and 1, with the closer to one the better the health of the stream. *The Kinderhook Creek tested in at 0.95, again showing that the Kinderhook Creek is a non-impacted stream.*

Biotic Index

The biotic index summarizes the different pollution tolerances of the families that make up the benthic macroinvertebrate community with a single value. Each family is given a pollution tolerance (from 0 to 10) with 0 being intolerant and 10 being the most tolerant. The results lie between 0 and 1, with the closer to 1 the better. The New York state standard for non-impacted streams is between 0 and 4.50. *The Kinderhook Creek tested at 2.64, proving once again that the Kinderhook Creek is a non-impacted stream.*

Percent Contribution of Dominant Family

This percentage is simply the percentage of the sample made up of the most abundant family. A sample dominated (more than 50%) by one family may denote an

impacted body of water. *The Kinderhook Creek tested at 18%, which further reiterates that the Kinderhook Creek is a non-impacted stream.*

Percent Model Affinity

The percent model affinity is the measure of the similarity of the Percent Composition of Selected Major Groups of the sample to that of a model "non-impacted" community. The New York state standards for non-impacted bodies of water is a percent model affinity greater than 64. *The Kinderhook Creek tested at 80%, which again shows that it is a non-impacted body of water.*

Percent Compostion of Major Groups

The Percent Composition of Major Groups is the percent of the sample in selected major groups. These groups are Ephemeroptera (mayflies), Plecoptera (stoneflies), Trichoptera (caddisflies), Coleoptera (beetles), Chironomidae (midges), Oligochaeta (worms) and other. In general, mayflies, stoneflies, and caddisflies should be well represented. If these groups are absent entirely, this indicates a problem in the stream. As a group, stoneflies are the most sensitive to pollution, and make up a small percentage of the sample. *The New York state standard for percentage of stoneflies per sample is 5%, and the Kinderhook Creek tested in at 6% which is normal*. Mayflies are also very sensitive to pollution, and they usually make up a significant portion of the sample. *The New York state standard for mayflies is 40% and the Kinderhook Creek tested at 42% which is normal.* If neither mayflies nor stoneflies are present, the stream may be moderately to severely degraded. Caddisflies are less sensitive to pollution, and it is rare to find a sample with no caddisflies. If the sample is dominated by worms or midges, the stream may also be seriously degraded. *Worms and midges were at 3% and 4% respectively, which is also normal. This data further illustrates the fact that the Kinderhook Creek is a non-impacted stream.*

Fecal Coliform

It is important to collect data on fecal coliform in bodies of water for several reasons. When fecal matter is introduced into a stream, pathogenic (disease-causing) bacteria, viruses, and parasites may be introduced which could pose as a health hazard to those people and animals that come in contact with the water. The threat becomes more serious as the population density increases and more people come in contact with the contaminated water and more sewage pollutes the water. Rather than test water directly for certain pathogens, which can be very expensive, the water is tested for fecal matter. Fecal matter is home to a host of different bacteria, some of it harmful and some of it not harmful. These bacteria can be used as indicators of the condition of the stream. If fecal coliform is present, it can be concluded that there has been fairly recent fecal contamination, and not necessarily from a human source. Farms near a body of water can often have animal waste in their runoff which can enter the stream or body of water and contaminate it. Fecal coliform bacteria counts are often used to regulate waters that are used for public recreational use, shellfishing, and drinking. If the fecal coliform bacteria counts are above 200 colonies per 100 ml of water, there is a fairly good chance that

pathogenic bacteria are present in the water and a person who comes in contact with of drinks the water has a higher chance of getting sick. *The Kinderhook Creek tested at 160 colonies per 100 ml of water, which is inside of the standards for drinkable water, but there is a chance that if the fecal coliform count got much higher, people could get sick if they drank the water.*

SUMMARY

Physical Parameters

The stream itself is the site of The Kinderhook Creek Public Fishing Access. The streambed is mostly made up of gravel with some sand and a small amount of cobble. The average depth is 2 feet and the average width is 45 feet. It has an average flow, and the water is mostly clear with a hint of tea coloring. The majority of the bottom of the creek is coated in algal coating, and there is about a 25% to 50% embeddedness. About 75% of the stream is covered in an overhead canopy, and both of the banks were made up of mostly hardwood trees with some shrubs and some grass. The setting is dominantly wooded area with roads, grazed pastureland, ungrazed meadowland, and it is located near a dairy farm, a park area, and scattered residential areas. There is nothing too unusual about the stream, although there is a concrete bridge that runs above it at a certain point and straightens the banks of the river with the bridge's concrete siding. There wasn't any notable pollution other than a car seat or a couch located in the water directly underneath the bridge.

Chemical Parameters

At the Kinderhook Creek, we tested for pH, turbidity, alkalinity, phosphates, nitrates, temperature, and dissolved oxygen levels. All of the levels of these different chemicals met the New York state standards for a class C body of water used for trout spawning.

Biological Parameters

At the Kinderhook Creek, we collected benthic macroinvertebrates to gather data from, and we also tested the water for fecal coliform bacteria. All of the results we gathered were in regulation with the New York State water quality standards for a class C body of water used for trout spawning.

CONCLUSIONS

1. Based on the results gathered from the physical assessment of the Kinderhook Creek, the creek is a healthy stream.

2. Based on the results gathered from the chemical assessment of the Kinderhook Creek, the creek is still a healthy body of water and is chemically safe for trout spawning purposes, which is what it is classified for.
3. Based on the collection of benthic macroinvertebrates from the Kinderhook Creek, the stream is very healthy and meets every single New York State standard for a class C body of water for trout spawning.

4. Based on the results gathered from the fecal coliform test on the Kinderhook Creek, there is enough fecal coliform to cause an impact on the creek but if the results were a little higher, the water could potentially be unsafe for humans to drink. However, seeing as the waters of the creek are not meant for drinking and instead meant for trout spawning and fishing recreationally, there should be no problem.

5. According to all of the results and the data we gathered as a class, we can safely conclude that the Kinderhook Creek is a healthy and non-impacted body of water that is safe for its intended purposes, recreational fishing and trout spawning.

SUGGESTIONS

Based on the healthy condition of the stream, there are very few suggestions we have to make it better. There are just a few things that could possibly be worked on.

1. Continue to make sure there is enough of a riparian buffer between the pasturelands and the meadowlands and the stream.

2. Make sure that no livestock comes closer to the stream and try to limit the amount of possible animal waste runoff from the farms nearby.

3. Have groups continually monitor the stream to make sure that it stays healthy and clean, and have groups submit their data and written findings every so often.