Citizen Science Year End Project Summary Report
2023

Project Title:
Longterm Water Quality Analysis of Three Streams

No of active volunteers:
3

Season Schedule:
Samples and data collected monthly using YSI monitoring device. Water samples are filtered, freezer stored, and delivered periodically to the Chesapeake Biological Laboratory in Solomons, Maryland to be analyzed later for dissolved nutrient concentrations

Total # of field project hours (incl field, data, etc.):
Estimated total hours: 980

Project Overview:
The top three pollution sources plaguing the Chesapeake Bay and the Patuxent are sediment, nitrogen, and phosphorus. The headwaters of these streams (Galloway Creek, Pindell Branch, and Two Run Creek) lie beyond Jug Bay's protected land. Therefore, human activities upstream in the watersheds can contribute to habitat degradation and reduced water quality. The major sources of human-caused pollution loads entering the river are wastewater treatment facilities, agricultural runoff, and acid precipitation. Organizations working to restore the health of our waterways have accomplished much to reduce point source pollution, but there is much work to do to reduce nonpoint source pollution. The Sanctuary began an investigation of the role of three tributary streams draining directly to the river in the mid 1980s and then was revised in 2010. Objectives:
- track the loading to the river of dissolved nutrients from tributary streams
- gather baseline data on dissolved nutrient concentrations, chemical attributes and physical characteristics of water at Two Run Branch, Pindell Branch, and Galloway Creek
- educate and train volunteers in the study of water quality and the dynamics of physical characteristics in a stream
- share our findings with the scientific and resource protection community

Methods:
This protocol collects samples at two main points along the stream: (1) near where the streams enter JBWS (upstream), which represents water quality from the watershed; and (2) downstream above the head of tide, which represents the water quality after the natural processes occurring within the Sanctuary. The following variables are collected and recorded on field data sheets, examined by staff for accuracy, and later transferred by staff and volunteers to computer spreadsheets for analysis.

Dissolved oxygen (DO) - Dissolved oxygen is a measure of the amount of oxygen (O2) dissolved in the water. Oxygen is a necessary element to nearly every form of life. As dissolved oxygen levels in water drop below 5.0 milligrams per liter (mg/l), aquatic life is put under stress; the lower the concentration, the greater

the stress. Oxygen levels that remain below 1-2 mg/l for a few hours can result in large fish kills.

Acidity (pH)- The degree of acidity not only limits life within the stream, but also affects those animals who need streams for everything from drinking to breeding to a food source. A pH of 6.5 to 8.2 is optimal for most organisms.

Temperature-Temperature is one of different factors determining which species may or may not be present in a stream. Temperature affects the feeding, reproduction, and metabolism of aquatic animals. Thermal pollution (water running off hot roads and roofs) is a growing threat to species of cold-water streams. Temperature can also affect other parameters such as DO.

Salinity- By definition, streams are not the place for salinity-loving creatures. Increased salinity due to erosion or runoff can change the basic nature of a freshwater stream.

Chemical compounds - The concentrations of nitrates, phosphates, and ammonia determine the nutrient level of the stream.

Nitrite/Nitrate (NO2+3) is essential for plant growth, but the presence of excessive amounts in water supplies presents a major pollution problem. Nitrogen compounds may enter water from agricultural fertilizers, human sewage, industrial wastes, and livestock wastes. Nitrate level should be less than 0.5 mg/l.

Phosphates (PO4) are naturally occurring. However, when found in excess they can accelerate the growth of algae and aquatic plants, causing eutrophication. Phosphate levels should be less than 0.05 mg/l.

Ammonium (NH4) is found in fertilizers. It is also used in refrigeration. As a decomposition product of urea and protein, it is found in wastewater. Toxic levels of NH4 are pH- and temperature-dependent. Ammonium concentrations should be less than 0.05 mg/l.

Conductivity is a measure of the ability of water to pass an electrical current. Conductivity in water is affected by the presence of inorganic dissolved solids such as chloride, nitrate, sulfate, and phosphate anions (ions that carry a negative charge) or sodium, magnesium, calcium, iron, and aluminum cations (ions that carry a positive charge). The basic conductivity measurement unit is the mho or siemens. Conductivity becomes critical only when studying other indicators of water quality, and is not in and of itself a major indicator.

Key Findings:

Summary of Results from 2010 - 2019 Water Quality Study found the following.

- The watersheds of the three streams flowing through the Sanctuary differ in size, degrees of land use, and human population size. Our results show that none have a pristine, or “natural,” condition. The biota are the most sensitive indicators of degradation: the streams’ aquatic habitat is rated mostly Fair to Poor.
- Two-Run Branch has historically provided the best aquatic environment for fish and macroinvertebrates, rating Fair to Good. Recent biological data suggests that these conditions may be declining, yet water chemistry in Two Run is within acceptable levels.
- Galloway Creek is the most degraded of the three streams, showing elevated nutrient levels and poor aquatic habitat. This is not surprising considering the stormwater runoff from roads and wastewater treatment effluent that the creek receives.
- Though more healthy than Galloway, Pindell Branch, flowing through the smallest, least populated watershed, shows evidence of somewhat elevated nutrient levels, which may originate from

nearby agricultural land. This may contribute to less desirable biological conditions.

- Across the streams, elevated nutrient levels generally decreased from upstream to downstream sites. Phosphate may be removed by being adsorbed by sediment particles, and nitrates may be taken up by plants. Further study of this phenomenon of nutrient removal--and the exceptions to it--may reveal more about the mechanisms at play.

Impact:
Impact on wildlife includes increases in certain species of fish, such as blue catfish, and decreases in other species due to increased salinity and sediment loads. Example: Ospreys and big game fish have suffered to decreased levels of their primary food (e.g, menhaden fish) in southern section of river. 2023 is being reported as the worst reproductive season of ospreys since DDT issue. (Source Greg Kearns) Fish such as Brook Troup that require water > 20 degrees centigrade, high O2, low silt, moderate pH have virtually disappeared. (Source: DNR Stream Health website http://www.dnr.state.md.us/streams)

Challenges Faced:
One YSI monitoring device is used by both the stream monitoring team and the vernal pool group; ensuring consistency of data capturing processes is difficult. The display screen on the device is small and dark (black on gray) that is difficult to read. In addition, the device needs regular callibration to ensure accuracy.

Recommendations:
Connect with other local water quality advocates to compare/contrast with their current data collection efforts and analysis. Coordination contacts include:, Patuxent Riverkeeper Fred Tutman, Maryland DNR, Chesapeake Bay National Estuarine Research Reserve (CBNERR) and authors of Maryland Big Stream Survey and hosts of Eyesonthebay.net, and MD wildlife managers. Goal to consolidate efforts towards comprehensive use of this data for decision making This could result in the collection of additional data elements such as turbidity (cloudiness in water caused by suspended materials that scatter light passing through the water measured using a tube that shows the depth at which one can see the water), bacteria, and PSAs levels.

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