Are Macroinvertebrates Vermont Strong?

Monitoring One Stream's Recovery and Water Quality after Tropical Storm Irene ; Investigating the Conventional Belief that Flooding and Stream Dredging have an Inverse Impact on the Overall Health of a Stream.

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Introduction

The object of this science project was to monitor the water quality recovery of Beaver Brook in Wilmington, VT after the damage done by tropical storm Irene. This stream's landscape was completely changed by Tropical Storm Irene. After the August 2011 storm, Vermont allowed a brief suspension of Act 250[3], which regulates dredging practices. During this time, necessary dredging took place to try to recover the lost land and to channel the stream to its previous position. Before Act 250, dredging was a common method of stream control. Act 250 was instituted in 1970 to control land use and the effect of human impact on the Vermont landscape. As a result, in an effort to protect natural stream ecology, dredging ceased except by state permission. Studies do show that indiscriminate dredging can cause serious harm to streams.[7] Thus, dredging is usually discouraged by the Vermont Agency of Natural Resources (ANR).

Post Irene, the local community questioned whether some form of dredging would have minimized the overall economic loss. Devastated by Tropical Storm Irene, a few local shops in Wilmington were not only severely damaged, but they floated down stream. Could dredging have possibly reduced this severe economic loss? Research was needed to investigate the possibility of whether selective dredging and scheduled channel restoration might be an option to prevent disastrous flooding. As there are many variables associated with stream ecology, this research focused primarily on the impact of dredging one Vermont stream in relation to the overall water quality levels.

Methods

As a participant in the Vermont EPSCoR Streams Project, my method to discern the overall water quality was as follows:

•Sampled *E. coli*, Total Phosphorus (TP), and Total Suspended Solids (TSS) in the stream twice a month

•Sent the samples to be tested at the Vermont EPSCoR Streams Project Lab.

•Twice during the sampling year, macroinvertebrates were collected from four different riffles in each stream. After the August flood, the samples were taken in September and then again in October.

•Obtained specimens using the random sampling method.

•Identified the macroinvertebrates using the *Guide to Aquatic Invertebrates of the Upper Midwest,* a Stereoscope, and the assistance of the Biology Department at St. Michael's College.

•Designated the flooding from Tropical Storm Irene and the subsequent dredging as the independent variable; the overall water quality was designated as the dependent variable.

•Compared the *E. coli*, TP and TSS of 2011 to the data from the previous two years by creating a bar graph.

•Created pie charts and a bar graph to compare the quantities of the *Ephemeroptera, Plecoptera and Trichoptera* (EPT), macroinvertebrates that are intolerant to pollutants, to the total numbers of macroinvertebrates, further identifying the water quality.

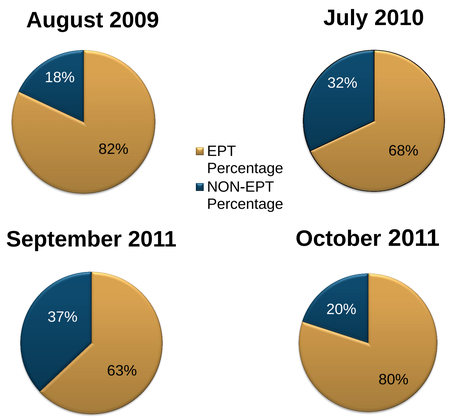
•Reviewed the findings to test the hypothesis.

Additional Information

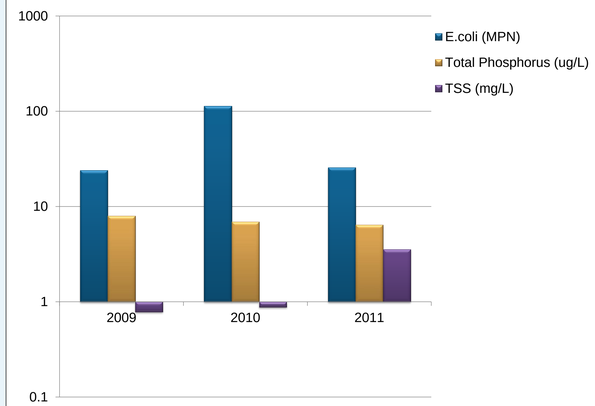
Vermont EPSCoR Streams Project: http://www.uvm.edu/~epscor/new02/

Team Huntley: knitgirlvt@gmail.com

Macroinvertebrate Percentages

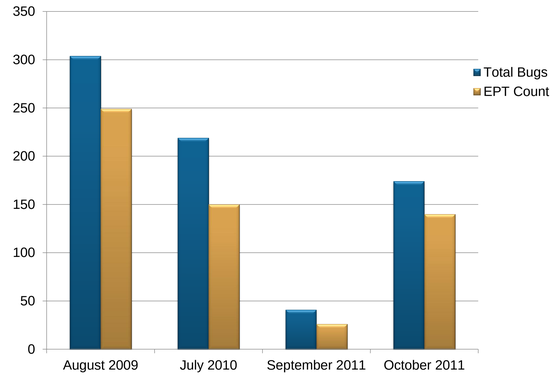


Overall Water Quality



Date	*E.coli* (MPN)	Total Phosphorus TP (ug/L)	Total Suspended Solids TSS (mg/L)
2009	24	7.95	0.78
2010	112.98	6.91	0.88
2011	25.73	6.43	3.53

Overall Macroinvertebrate Quantities



Date	Macroinvertebrate Total Quantities	EPT Total Quantities
August 2009	304	249
July 2010	219	150
September 2011	41	26
October 2011	174	140

Results

From the research, it was found that the water quality almost completely recovered to normal levels in only two months. As hypothesized, macroinvertebrate levels were almost completely decimated in September. By October, the quantities of macroinvertebrates were near to the prior two year's levels. The EPT versus the other orders of macroinvertebrates exhibited consistent percentages throughout the samplings. *E.coli* levels were about the same as the previous sampling years. It is interesting to note that TP levels were on a steady decline since 2009, and that decline continued after the flooding. TSS levels did go up by 3 mg/L, but this is to be expected because TSS are the suspended particles that float in the water. These particles were brought up from the bottom of the stream by the increased turbidity that came with the flooding. From this research, it appears that, although the flooding did cause major damage to the town, flooding and dredging do not have an adverse impact on the overall health of a stream. As exhibited in the research, the water quality of Beaver Brook is again maintaining homeostasis.

Conclusion

Act 250 is a law, regulated by the ANR, which provides criteria for restricting land use for the protection of Vermont's landscape. The goal of Act 250 is; "to regulate and control the utilization and usages of lands and the environment to insure that, hereafter, the only usages which will be permitted are not unduly detrimental to the environment, will promote the general welfare through orderly growth and development and are suitable to the demands and needs of the people of this state...."[4] Act 250 has ten criteria (see below) that are very subjective because of the way they are worded. These ten criteria use words that do not have concrete definitions, for example, "unreasonable and undue" As such; this law can be enforced in a way that is so restrictive that it may put more precedence on the health of the stream, instead of having a balance between the stream's health and the economy of the surrounding towns. The Beaver Brook's health quickly recovered after the tropical storm Irene and dredging, but the town was devastated. Dredging of Beaver Brook proved to not be detrimental to the stream's health, so now working to protect the town village from future flood destruction is necessary.

From this research, it is recommended that Act 250 be amended to create concrete best management practices that will ensure a balance between healthy stream ecology, while reducing vulnerability, loss and public safety hazards to the town during the next flood.[8] The research supports this recommendation because within two months of the flood disaster recovery, the stream was nearing its previous levels of water quality. The solution to preventing another flood related dilemma could include selective dredging and stream channel restoration practices that are carefully monitored and performed on a regular basis. There should be more particular criteria for discerning whether dredging should be permitted. Dredging could be a solution to help prevent such momentous devastation in the surrounding towns after flooding without having a serious impact on the health of the stream. A post Irene study of stream health on rivers that were dredged throughout the state would be a project for future research.

Ten Criteria of ACT 250

Before granting an ACT 250 permit, the District Commission must ensure that the development or subdivision meets the following criteria:

1. Will not result in undue water or air pollution.
2. Has sufficient water available for the needs of the subdivision or development.
3. Will not unreasonably burden any existing water supply.
4. Will not cause unreasonable soil erosion or affect the capacity of the land to hold water.
5. Will not cause unreasonably dangerous or congested conditions with respect to highways or other means of transportation.
6. Will not create an unreasonable burden on the educational facilities of the municipality.
7. Will not create an unreasonable burden on the municipality in providing governmental services.
8. Will not have an undue adverse effect on aesthetics, scenic beauty, historic sites or natural areas, and 8(A) will not imperil necessary wildlife habitat or endangered species in the immediate area.
9. Conforms with the Capability and Development Plan which includes the following considerations:
10. Is in conformance with any local or regional plan or capital facilities program.[4]

Acknowledgments

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