CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Vijay Yanamadala

Project Number
S0818

Project Title
Eutrophication Control with Ion Exchange Filters and Accelerated Denitrification in Fresh Water: Bacterial Analysis

Abstract

Objectives/Goals
Eutrophication, the process by which a lake becomes rich in dissolved nutrients due to point and non-point pollutant sources, is a major cause of the loss of natural lake ecosystems throughout the world. The goal of these experiments has been not only to improve the ecological balance of lakes by reducing eutrophication, but also to better the ecosystem from an environmental and health perspective.

Methods/Materials
Previous experimentation involved the testing of calcium carbonate as a phosphate binder in the laboratory and in the real ecosystem. Various approaches for reduction of ammonia were also tested including aeration, use of bacteria growth medium, and plants, mainly in an attempt to increase population of Nitrobacter and Nitrosomonas.
The effect of phosphate and ammonia reduction on the populations of enterobacteria was the main focus of this experiment. Varying concentrations of phosphate, ammonia, and calcium carbonate in conjunction with phosphate were tested in Madrona to determine their effects on the populations of enteropathogens on non-specific blood agar, MacConkey agar, and Hektoen agar.

Results
Calcium carbonate was found to be an excellent phosphate binder, reducing up to 70% of the phosphates. There was a strong correlation between phosphate concentrations and bacterial populations: a 66% decrease in phosphate resulted in a 35% reduction in bacterial populations and a 45% reduction in enteropathogenic populations. Likewise, a strong correlation was shown between calcium carbonate concentrations greater than that which can be attributed to the phosphate reduction alone.

Conclusions/Discussion
The experiment was extremely successful in designing a working phosphate binding and ammonia reducing filter, and a large-scale filter is currently being constructed in Madrona Marsh; this filter will reduce phosphate and ammonia levels substantially in the following years, and also reduce the populations of pathogenic bacteria in the water. The results of this experiment will hopefully improve the Madrona Marsh Preserve in many different ways: ecological, economical, and health-wise.

Summary Statement
Ion exchange reduction of phosphate and accelerated denitrification can significantly reduce eutrophication and populations of harmful enteropathogens, thus leading to the betterment of lake ecosystems.

Help Received
Lab space in Physics classroom; Parents helped with driving, etc.