The Effects of Storm Runoff on Long Island Sound Dissolved Oxygen Levels

NRCA Student: Ethan Skuches[1]

Community Partners: Bridget Cervero[2], Sarah Nahabedian[2]

[1]Joseph A. Foran High School; [2]The Maritime Aquarium

ABSTRACT

Housing, industrial, and agricultural development along coastal areas of the Northeastern United States is especially prevalent along the Long Island Sound (LIS). Water runoff from such development, often containing fertilizers and other nitrogen-containing products, accumulate in the LIS, contributing to algal blooms, eutrophication, and harmful levels of hypoxia. This project sought to understand the relationship between rainfall, fertilizer and other nitrogen-containing products, and dissolved oxygen levels (DO) in the LIS. Data for DO, temperature, and rainfall were collected during cruises on the R/V Spirit of the Sound, the Maritime Aquarium's research vessel. I also ran an experiment assessing the effects of runoff from grass treated with different fertilizers on DO levels in LIS water. Although the experiment results were inconclusive, our results from the LIS show a slight correlation between rainfall and low DO levels in the LIS, which suggests that water runoff may have an effect on the greater marine ecosystem in LIS.

INTRODUCTION

Eighty-eight percent of the population in the Northeastern United States lives in coastal counties[1]. Other development accompanying this settlement trend include industrial factories, various types of land use, and farming. Water runoff from such developments contain fertilizers and other nitrogen-containing products, which accumulate in marine systems such as Long Island Sound. Water runoff can contribute to harmful algal blooms, which can result in eutrophication and low DO levels, or hypoxia (low oxygen level that is dangerous to most marine organisms)[2]. DO is the amount of oxygen in the water available to marine organisms. Low DO levels can pose dire issues for the marine life and result in the death of marine communities and populations in certain areas. Beginning over the past 100 years, Long Island Sound itself has a history of issues pertaining to eutrophication[3] (define briefly what eutrophication is here). As such, the purpose of this study was to understand the relationship between rainfall, fertilizer and nitrogen-containing products, and DO levels by: (i) examining the trend of DO levels in the LIS and rainfall; and (ii) assessing the impact of fertilizer runoff on the DO levels in the brackish water of the LIS.

Fig 1. Sarah and myself obtaining and recording DO readings at the dock for the *R/V Spirit of the Sound* at the Maritime Aquarium in Norwalk, CT.

ACKNOWLEDGEMENTS

I want to thank Bridget and Sarah for lending their time and help along with resources at the Maritime Aquarium. I also want to thank Ms. Gladych at BRASTEC in Bridgeport for allowing me to use her YSI for the experiment and Lisa Krall at NRCS for lending the rain simulators. Finally, I want to thank Laura for orchestrating the whole experience and being there if any issues occurred.

METHODS

LIS Readings

- DO readings were obtained at the docking site for the R/V Spirit of the Sound vessel at the Maritime Aquarium in Norwalk, CT (Fig. 1).
- Between June 21 and August 28, 2016, DO and temperature readings were obtained using the YSI 550A Dissolved Oxygen Instrument (Geotech Environmental Equipment, Inc., Denver, CO).
- Rainfall events and accumulation were recorded and obtained from June 21 and August 28, 2016 as well.
- DO, temperature, and rainfall data were compiled into a spreadsheet in Excel and graphed to assess trends.
- Periods of hypoxia were identified when DO dropped below 5.0 mg/L.

Fertilizer Runoff Experiment

- Three rain simulators (Fig. 2) were used to simulate fertilizer runoff in the LIS.
- Each rain simulator consisted of three parts: upper basin with holes, planter base with local soil and grass, and lower basin with 473 ml water collected from the LIS.
- The upper basin water in each simulator was treated with either Miracle-Gro Water Soluble Lawn Food (Scotts Company, Marysville, OH), Purely Organic Liquid Lawn Food (Reinertson, Seabrook, NH), or tap water (as a control) according to instructions (Fig. 2).
- After 24 hours, a moderate drizzle of tap water was applied to each rain simulator, and any Water Runoff was collected into the lower basin containing LIS water.
- The DO of the lower basin was recorded using a YSI 550A Dissolved Oxygen Instrument (Geotech Environmental Equipment, Inc., Denver, CO) both prior to and immediately following the drizzle.

Fig 2. Three rain simulators comprised three parts each: an upper basin with holes, a planter base with local grass and soil, and a lower basin with LIS water. In two of the simulators fertilizer (Miracle-Gro Water Soluble Lawn Food or Purely Organic Liquid Lawn Food) and tap water were placed in the upper basin, and in the third simulator, no fertilizer was included in the tap water in the upper basin (control).

METHODS

LIS Readings

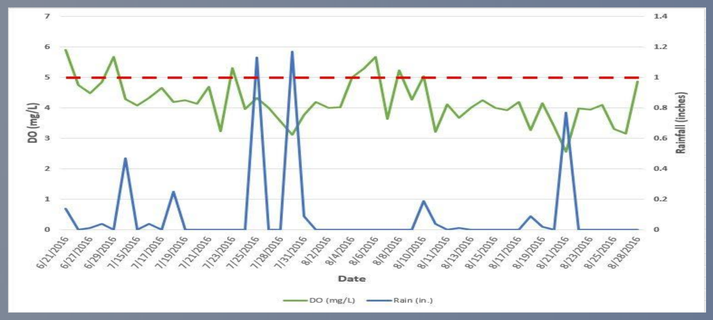

Fig 3. Dissolved oxygen (DO) levels in the LIS as well as rainfall recordings at the Maritime Aquarium throughout the summer. DO levels below the red dashed line of 5 mg/L indicates hypoxic conditions—levels considered to be strenuous for fish to survive.[2]

Fertilizer Runoff Experiment

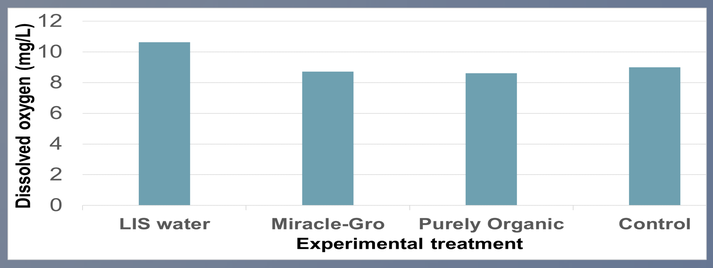

Fig 4. DO levels obtained from the LIS water and the lower water basin of each rain simulator following treatment.

CONCLUSIONS

Based on our findings, there was a slight correlation between water runoff (rainfall events) and LIS DO levels (Fig. 3). These findings are important to conservation as they demonstrate that while there may not be an overwhelming correlation between DO levels and runoff, there is some. The general results of data collection are significant as they demonstrate a trend that has been occurring in LIS over the past century, which is a low DO level with many bouts of hypoxic events (Fig. 3).

The fertilizer runoff experiment results were inconclusive (Fig. 4). Although the DO decreased by nearly 2 mg/L following the fertilizer treated water, the control water experienced a similar trend. As such, more research on DO and fertilizer water runoff should be done in order to determine the reasons for decreased DO.

REFERENCES

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