SUMMER 2021 WATER QUALITY ANALYSIS ALONG THE TOMS RIVER

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Introduction

- Water quality is a measurement of the physical, chemical, biological, and microbiological characteristics of water; long-term testing is vital to understand the health of a water system (Myers, 2019).
- Water temperature can determine the aquatic organisms that reside in the system, as it affects the amount of dissolved oxygen (DO) for organisms to consume, and higher temperatures can lead to lower DO (Safe Water Drinking Foundation, 2021; Sarasota County, 2021).
- Chlorophyll indicates photosynthetic rates, and higher rates lead to higher levels of DO (OzCoasts, 2021).
- Salinity can influence DO because when salinity increases, the solubility of DO decreases as there is less space for oxygen to be in water. Salinity is also related to pH since salts can influence the parameter (PreSens Precision Sensing, 2021).
- Total suspended solids (TSS) can affect turbidity, the measure of clarity of water, as suspended solids can influence how clear water may be (Lake Superior Streams, 2019).

Site	Location	Latitude	Longitude
TR1	Lakehurst Road	39°57'25.1"N	74°12'36.0"W
TR2	Hooey Park	39°57'03.5"N	74°11'51.1"W
TR3	Jakes Branch	39°56'48.3"N	74°11'46.4"W
TR4	Beachwood Beach	39°56'32.6"N	74°11'01.7"W
TR5	Harpoon Beachwood	39°56'24.5"N	74°10'52.3"W
TR6	Woody Cove Pine Beach	39°56'20.7"N	74°10'39.3"W
TR7	Avon Road Pine Beach	39°56'22.6"N	74°10'19.2"W
TR8	SBB Waterfront	39°94'81.3"N	74°96'71.2"W
TR9	Money Island Riviera	39°56'48.6"N	74°09'23.7"W
TR10	Dillon's Creek	39°56'43.6"N	74°08'36.5"W
TR11	Dillon's Creek Marina	39°56'40.3"N	74°08'08.3"W

Figure 1: Sample sites along the Toms River in New Jersey. Tested municipalities were Toms River, South Toms River, Ocean Gate, Beachwood, Pine Beach, and Island Heights. Sampling occurred from 11:30 to 13:00 GMT from June 7 to July 27, 2021. Two teams collected water samples for analysis *ex situ* at the Save Barnegat Bay EcoCenter in Toms River, New Jersey.

Methodology

- Sampling was conducted from June 7 to July 27, 2021. Sample sites consisted of eleven locations along the Toms River (**Figure 1**).
- 300 mL of water was collected at each sample site.
- An AquaFluor® Handheld Fluorometer and Turbidimeter was used to collect chlorophyll (RFU) and turbidity (NTU) readings.
- An Oakton™ 5 Handheld pH Meter was used to determine pH levels (**Figure 2**).
- A YSI™ 556 Multiprobe Water Quality Meter was used to collect water temperature (°C), salinity (PPT), and dissolved oxygen (mg/L) (**Figure 2**).
- A vacuum filtration system was used to collect TSS levels (ppm). Filter paper was massed to know the initial mass. 100 mL of water from each sample site was used during vacuum filtration. The final mass was measured for each paper and the difference between masses was recorded.
- Meteorological events such as rainfall and tides were observed.

Figure 2: An AquaFluor™ Handheld Fluorometer and Turbidimeter was used to measure chlorophyll (RFU) and turbidity (NTU) of the water samples. An Oakton™ 5 Handheld pH Meter was used to determine pH of the water samples. A YSI™ 556 Multiprobe Water Quality Meter was used to collect water temperature (°C), salinity (PPT), conductivity (mS/cm), and dissolved oxygen (mg/L) of the water samples *in situ* (pictured left to right).

Objective

Gain an understanding about basic water quality conditions of the Toms River. Determine areas that may be sources of pathogenic bacteria that have a negative impact on water quality along the Toms River, and consequently, Barnegat Bay, New Jersey.

Results

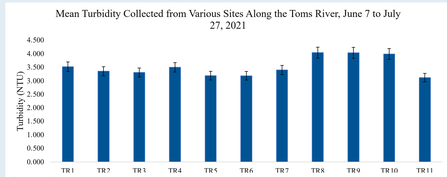

Figure 3: Mean turbidity (NTU) at various sample sites along the Toms River from June 7 to July 27, 2021 (±5% error). Turbidity readings ranged from 1.036 to 9.660 NTU. An ANOVA comparing the mean turbidity at each sample site yielded an approximate *p*-value of 0.12, suggesting no significant difference in turbidity levels among locations ($\alpha = 0.05$, $n = 176$).

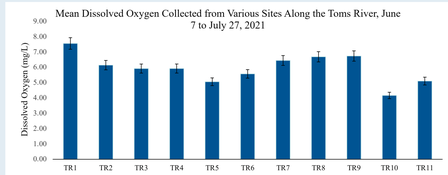

Figure 4: Mean dissolved oxygen (mg/L) readings at various sample sites along the Toms River from June 7 to July 27, 2021 (±5% error). DO levels ranged from 1.87 mg/L to 11.35 mg/L. An ANOVA comparing the mean DO at each sample site yielded an approximate *p*-value less than 0.001, suggesting significant difference in DO among sample sites ($\alpha = 0.05$, $n = 176$).

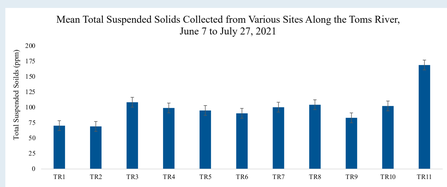

Figure 5: Mean total suspended solids (ppm) readings at various sample sites along the Toms River from June 7 to July 27, 2021 (±5% error). TSS levels ranged from <10 to 1070 ppm. An ANOVA comparing the mean TSS at each sample site yielded an approximate *p*-value 0.37, suggesting no significant difference in TSS among sample sites ($\alpha = 0.05$, $n = 176$).

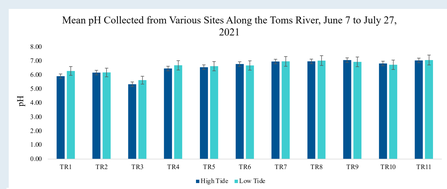

Figure 6: Mean pH readings at various sample sites along the Toms River from June 7 to July 27, 2021 (±5% error). pH levels ranged from 4.96 to 7.45. An ANOVA comparing the mean pH at each sample site yielded an approximate *p*-value 0.04, suggesting a significant difference in pH among sample sites ($\alpha = 0.05$, $n = 176$).

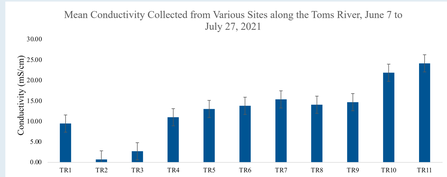

Figure 7: Mean conductivity (mS/cm) readings at various sample sites along the Toms River from June 7 to July 27, 2021 (±5% error). Conductivity levels ranged from 0.06 to 28.05 mS/cm. An ANOVA comparing the mean conductivity at each sample site yielded an approximate *p*-value 0.23, suggesting no significant difference in conductivity among sample sites ($\alpha = 0.05$, $n = 176$).

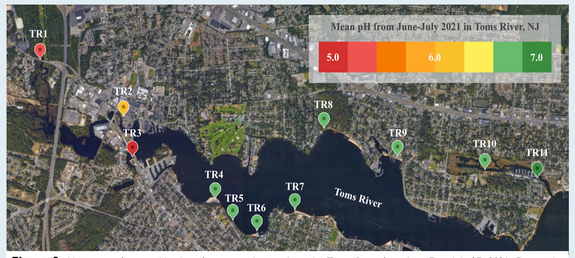

Figure 8: Heat map of mean pH values from several sites along the Toms River from June 7 to July 27, 2021. During the sampling period, pH readings ranged from 4.96 to 7.45. Sites TR1, TR2, and TR3 yielded mean pH values from 5.0 to 6.50. An ANOVA test comparing the mean pH levels among sampling sites yielded a *p*-value of 0.04, suggesting significant difference in pH levels among the locations ($\alpha = 0.05$, $n = 176$).

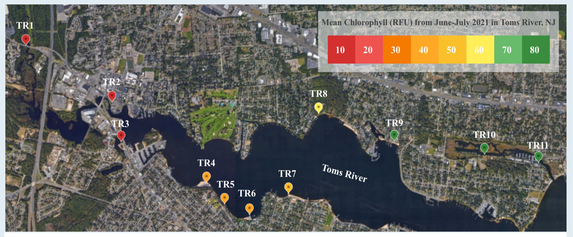

Figure 9: Heat map of mean chlorophyll (RFU) from several sites along the Toms River from June 7 to July 27, 2021. Chlorophyll readings ranged from <0.001 to 231.3 RFU. Sites TR1, TR2, and TR3 are located in the headstreams of the Toms River and have mean chlorophyll readings between 10 to 15 RFU. Sites TR9, TR10, and TR11 are located near the river mouth and have mean chlorophyll readings greater than 70 RFU. An ANOVA test comparing the mean chlorophyll levels among sampling sites yielded a *p*-value less than 0.001, suggesting significant difference in chlorophyll readings among the locations ($\alpha = 0.05$, $n = 176$).

Figure 10: Heat map of mean salinity (PPT) from several sites along the Toms River during tidal events. Sampling occurred from June 7 to July 27, 2021. Salinity readings ranged from <0.01 to 17.09 PPT. Salinity values increased west towards Barnegat Bay. An ANOVA comparing the mean salinities at each sample site yielded an approximate *p*-value 0.13, suggesting no significant difference in salinity among sample sites ($\alpha = 0.05$, $n = 176$).

Discussion

- Turbidity values were higher than last year, but are still under ten NTU, the standard turbidity for rivers at low tide; pollution and sediments could have influenced turbidity (**Figure 3**; United States Geological Survey, 2021).
- DO was significantly different between sites due to areas such as Dillon's Creek, which might experience low tidal activity, and water temperature differences (**Figure 4**).
- pH was significantly varied among sites; microbes and endemic plants could have influenced the pH readings. This can also explain why salinity and pH did not have a relationship, as these factors could have impacted the relationship (**Figures 8 & 10**; McGrane, 2020).
- Chlorophyll was significantly different between sites, as there could have been an increase of phytoplankton with less tidal flushing (**Figure 9**; Environmental Protection Agency, 2021).
- A reason why DO and chlorophyll did not share a relationship is that nutrient presence was not high, thus not allowing for photosynthesis to occur and produce oxygen (National Oceanic & Atmospheric Administration, 2020).
- Salinity did not have any significant differences between sites, which can be due to an increased freshwater influence and less tidal flushing (**Figure 10**).

Figure 11 (left): Members of Rally for Barnegat Bay analyzing water quality parameters on June 21, 2021. Testing was done at the Save Barnegat Bay EcoCenter in Toms River, New Jersey.

Figure 12 (right): Samples were taken from various sites along the Toms River, including Beachwood Beach (TR4).

Conclusion

The goal of this investigation was to gain an understanding of the basic water quality of the Toms River through various parameters. In this study, expected relationships were not found, and there were some significant differences of parameters between sites. Gaining knowledge of how and where pathogenic bacteria influence the Toms River can help people understand why there are locations with poor water quality results. In the future, relating these water quality parameters and the effect of pathogenic bacteria might be a viable solution to finding the locations of the Toms River which are struggling with overall poor water quality.

Acknowledgements

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