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Ebb Tide and Flood Tide: Effect on Benthic Fauna Richness

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Abstract

The dissolved oxygen (DO) levels in different water masses can fluctuate due to variations in tide dynamics, and this can have an impact on benthic fauna richness—the organisms living on the ocean floor or riverbeds. The purpose of this study was to investigate the unique effects of these ebb and flood tides on the variety of benthic species in Tom's Cove, which is situated in Virginia's Chincoteague Bay. Data were collected through the usage of a YSI ProDSS, an instrument that measures water conditions. A trawl net was also utilized to capture marine creatures on the water basin floor. Observations and trawl net captures were conducted at three distinct locations within Tom's Cove, once during an ebb tide and once during a flood tide in order to assess the effects of tide behaviors on benthic fauna richness. Results indicate that DO and richness within the benthic layer were higher during ebb tides, which is supported by previous studies that state DO can be higher due to reduced water mixing. This study underscores the importance of ebb-tide-induced higher DO concentrations, which promotes greater fauna richness in Tom's Cove's benthic layer. Further research can help scientists and environmentalists in comprehending the impact of DO fluctuations on benthic environments. Additionally, the fauna richness can be utilized as a water quality indicator for future water conservation efforts.

Introduction

Our project focuses on analyzing how fauna in the Tom's Cove marine ecosystem is affected by ebb tide and flood tide. An ebb tide describes an outflow of water from a body of water, while a flood tide represents water coming back into a body of water. The tidal cycle has a considerable impact on the richness of marine creatures, as well as the physical and chemical conditions of the coastal waters. By specifically studying the distinction between ebb tide and flood tide, we aim to investigate the insights of how these tidal phases influence the fauna present in the ecosystem.

As water exits during ebb tide, several water parameters change to an extent. These alterations could significantly impact several species and their behaviors. A flood tide, which occurs when water enters the ecosystem, may provide additional nutrients, promote mixing, and alter environmental conditions.

For numerous reasons, it is essential to understand the effect of ebb tide and flood tide on wildlife. First, it gives us a better understanding of how animals respond to tidal changes. Additionally, it allows us to evaluate the vulnerability of different fauna to changes that occur during the tidal phase. This research is essential in understanding the real-world implications of water condition altercations for coastal management and conservation activities.

Methods

The data collection of benthic water parameters and fauna richness was conducted at Tom's Cove in Chincoteague Bay, Virginia. Three collection stations were averaged to compare the water and fauna conditions between an afternoon ebb tide (May 22nd, 2023) and a morning flood tide (May 4th, 2023).

Water conditions including water temperature, salinity, dissolved oxygen, pH, and backscatter were measured using a thoroughly calibrated water condition measurer called the YSI ProDSS probe. The probe descended in half-meter increments until contact with the benthic layer and was then raised slightly. Secondly, a large trawl net was deployed and traversed the benthic surface in each location and day. After ample distance, it was raised, and benthic fauna richness was calculated by visual species identification.

Gathered qualitative and quantitative data were averaged and subjected to analysis using the Excel program. These processes and calculations included t-tests for variations, error bar identification, and significance analysis.

Results

Figure 1 illustrates calculations showing that benthic dissolved oxygen was higher during ebb tides than during flood tides. The average amount of dissolved oxygen in flood tides was 7.7 mg/L, while ebb tides had a value of 9.6 mg/L. Fauna richness observations concluded that richness was greater during ebb tides compared to flood tides (Figure 2). Four distinct species made up the fauna richness of the flood tide, compared to seven species during the ebb tide. The data obtained from the three locations inside Tom's Cove showed minimal fluctuation, as illustrated by the error bars. According to t-tests, there was a significant difference in fauna richness ($t=2.77$, $df=4$, $p<0.003$) and dissolved oxygen concentrations between ebb and flood tides ($t=2.77$, $df=4$, $p<0.0006$). The conclusion drawn from these numbers would be that there is evidence to reject the null hypothesis in favor of the alternative hypothesis, given the small pvalue.

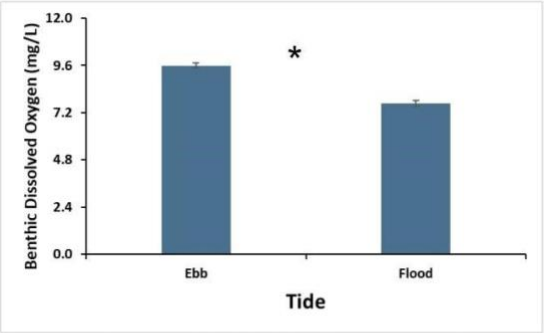

Figure 1. Average benthic dissolved oxygen (mg/L) between ebb tide and flood tide; error bars denote SE ($t=2.77$, $df=4$, $p<0.0006$).

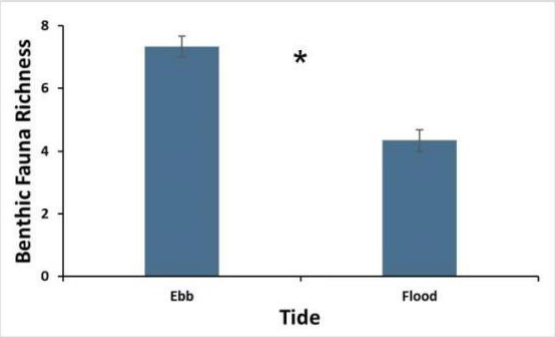

Figure 2. Average benthic fauna richness (number of species) within a trawl between ebb tide and flood tide; errors bar denote SE ($t=2.77$, $df=4$, $p<0.003$).

Discussion

This study presents a notable correlation between dissolved oxygen concentrations in Tom's Cove: greater concentrations of DO were observed during ebb tides, which is attributed to the elevated DO levels in the benthic layer. It must be noted that DO observations within the study could have been impacted by unobserved variables such as light and food input. However, our findings do correlate to previous studies that state DO is more concentrated in the benthic layer during ebb tide due to the lack of water mixing, which causes increased benthic oxygen deposition (Xia et al., 2011). In addition, the DO layers directly impacted the fauna richness quantity in a positive relationship. Previous studies support these findings as well as those seen in other bodies of water, such as the 1994 study in Long Island Sound (Howell & Simpson, 1994).

Overall, this work advances our understanding of large-scale ocean condition variations by sampling a specific region. It supports the premise that DO is crucial for benthic fauna diversity and ecosystem health, as well as a sign of quality water. Subsequent research can investigate the processes driving the observed DO oscillations and their implications for benthic ecosystems. For conservation efforts in Tom's Cove and other similar coastal regions, it may be useful to examine the broader implications of DO level changes on water quality and ecosystem health. Furthermore, fauna richness can be used as a water quality indicator in future ecosystem management and monitoring.

References

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