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Variation in Coastal Macroinvertebrate Species Diversity on Intertidal Boulders in Trinidad, California.

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Introduction

Coastal environments of Humboldt County are home to a diverse array of marine species. Luffenholtz Beach in Trinidad CA (Figure 1), features rocky intertidal zones and is home to several coastal macroinvertebrate (CM) species (Cimberg, 1975). This region has varying tidal regimes throughout the diverse boulder structures creating unique habitats for aquatic macroinvertebrates. CM species play an important ecological role by cycling nutrients through processing organic matter and making it available for other organisms (Stumpf, et. al, 2009). Boulder habitats on Luffenholtz Beach provide an optimal field of study due to its CM diversity and unique environmental conditions. The focus of this study is on the diversity of CM species on intertidal boulders. We hypothesize that there is a significant difference in the diversity of CM species based on species' habitat elevation on the surface of the intertidal boulders.

Methods

We collected data on October 20th, 2021 at Luffenholtz Beach in Humboldt County, California (41.0401249 N, -124.1200682 W). Tidal charts indicated a high-tide of 6 feet at 11:59 AM and a low-tide of 0.4 feet at 6:09 PM during the time of this study. We took two samples on the eastern side of each of five intertidal boulders (n=10). We counted CM species populations within a one- meter quadrant across two height strata (0-1 meters from base of boulder, and 1-2 meters from the base of boulder). The Shannon-Wiener diversity index (H') was the most appropriate tool to determine the level of diversity per one-meter quadrant measured (Beals, 2000). We then took the averages were then taken at each of the two regions of each boulder. We conducted a two-sample two-tailed t-test in order to determine if there is a significant difference in species diversity between the two regions. Based upon the results of an f-test, the t-test assumed equal variances ($P>0.05$).

Results

We observed eleven total species across all boulders. The resulting data has shown that species in lower regions of the intertidal boulders have a statistically significant higher level of diversity. The p-value from the t-test resulted in a value of 0.041. As shown in Figure 2, the lower region closest to the base of the intertidal boulders (0-1 meters) had on average a 0.452 higher H' diversity index value, than that of the upper region (1-2 meters).

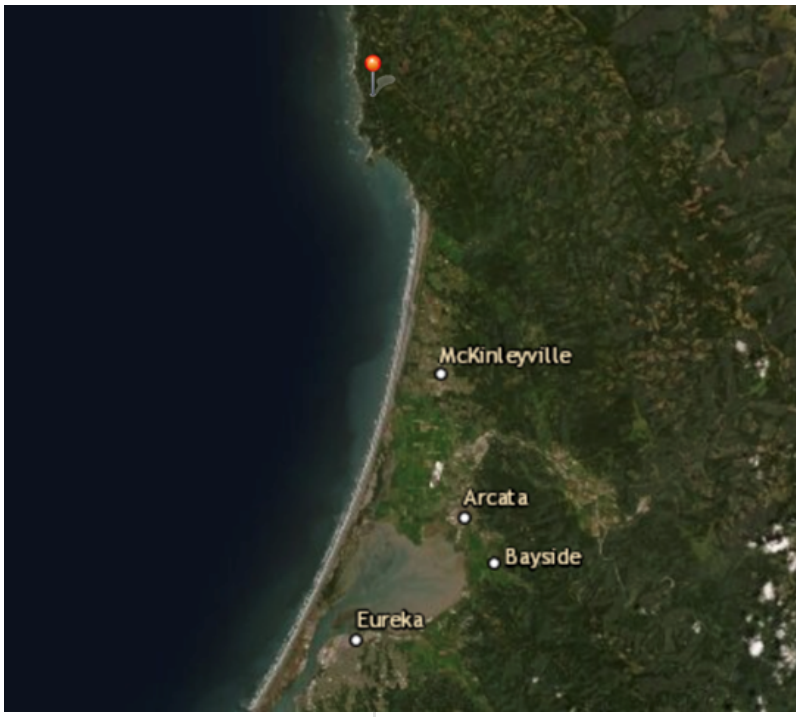

Figure 1. Map of study site in Humboldt County, CA.

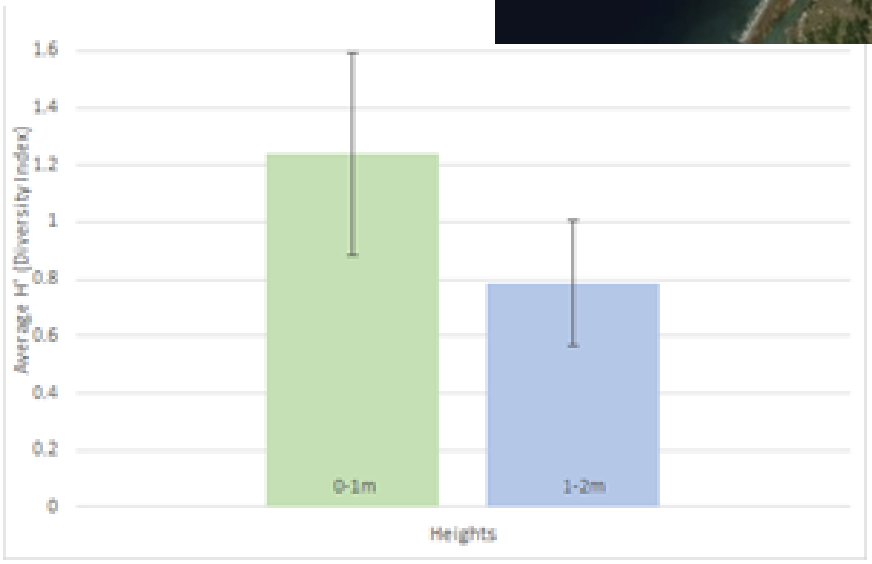

Figure 2. Average Macroinvertebrate Diversity Index (H') at each boulder height (n=10).

Discussion

The results from this study support our alternative hypothesis that there is a significant difference between the diversity of CM species based on their elevation on the intertidal boulders ($P<0.05$). The results of this study may be related to the processes of sessile species adaptation. Sessile CM species can survive on higher elevations of intertidal boulders, while mobile species lack the ability to withstand tidal forces—resulting in higher diversity in lower habitat elevations (Haris, 1990). Sessile species, such as Balanus glandula, use underwater adhesion attaching themselves to desired substrate (Kamino, et al. 2000). Some CM species at higher elevations will seal shut at low tide, reducing exposure to dry conditions and increasing water retention. These processes allow for the scoured substrate to become inhabitable. Variations in tidal range, when sessile species are open and feeding, allow keystone species, such as Pisaster ochraceus, to feed on Balanus glandula in high tide zones; Pisaster ochraceus then return to low tide zones during ebb tide (Lawrence, 2013). The results from this study may be explained by these CM species habitat interactions.

Potential sources of error in this study include a lack of topographic surveys to determine specific rock formations,

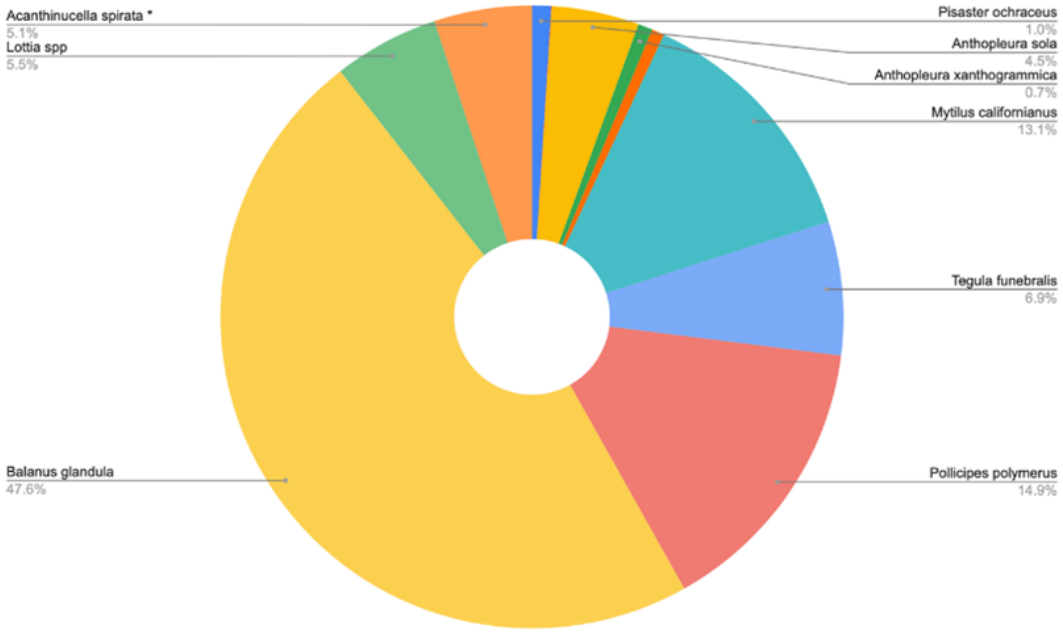

Figure 3. Average CM species population composition across all 5 boulders.

such as differences between boulder fields or benches which promote variation in species diversity along intertidal boulders (Craig, et al. 2017). Rock formation, in connection to elevation, may play a role in the variation of species diversity amongst intertidal boulders (Scrosati, et. al. 2011).

The data from this study indicate that the lower region of the measured intertidal boulder have higher levels of CM species diversity. This provides a better understanding of the habitats for aquatic macroinvertebrates Further research will be needed to better measure and understand CM species diversity in intertidal zones.

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