SMALL SCALE HEAT STRESS IS REGULATED BY BOTH MICROHABITAT AND UPWELLING

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RESUMO

Tropical intertidal organisms live close to its upper thermal limits and experience high variation in body temperature during the tidal cycle. Ectothermic organisms can show behavioral responses such as selecting shaded refuges as a temperature regulation strategy. Besides, temperate organisms don't suffer with extreme temperatures and have a greater acclimatization capacity when compared to tropical ones, because it occurs in a naturally more variable environment. Although this is well defined on a macroecological scale, no study has yet attempted to examine whether small scale factors can affect organisms from a same region, such as different thermal patterns caused by localized upwelling. Furthermore, little is known about how thermal refuges are used to regulate body temperature in this situation. Here, we evaluate how intertidal organisms body temperature varies according to the microhabitat and the influence of upwelling systems. We used data loggers developed to mimic the thermal characteristics of intertidal animals and placed in two microhabitats: i. thermal refuge (shaded areas) and ii. sun-exposed. The loggers were placed on two rocky shore areas: i. Praia Grande, highly influenced by upwelling with temperate affinities, and ii. Fortaleza, less influenced by upwelling with tropical affinities. Temperature was recorded hourly with a 0.5ºC precision from 2019 to 2023. We found higher mean daily temperatures at Fortaleza in all seasons ($p_{summer} < 0.001$; $p_{spring} < 0.001$; $p_{autumn} < 0.001$; $p_{winter} < 0.001$), especially in the microhabitat exposed to the sun. Daily temperature range was greater at Praia Grande for both microhabitats in summer ($p < 0.001$) and spring ($p < 0.001$) (months with more intense upwelling). However, against our expectations, we found greater thermal range at sun-exposed Fortaleza's microhabitat during autumn and higher similarity within microhabitats from both rocky shores in winter, regardless of upwelling influence. Maximum temperature was higher at sun-exposed microhabitats than shaded ones. In addition, we found differences in shaded and sun exposed microhabitats heating

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curves: sun exposed temperature peak occurs earlier and lasts longer while shaded temperature peak occurs in the late afternoon and lasts for a shorter period, especially at Praia Grande. Thus, shaded microhabitats not only provide protection from higher temperature, but also limit exposure time to the thermal stressor. We concluded that upwelling at different intensities can reproduce macroecological patterns on a small scale, depending on the microhabitat in which the organisms occur.

PALAVRAS-CHAVE: Intertidal organisms, Microclimates, Rock temperature, Sea water temperature, Thermal stress

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