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Substrate temperature as a primary control on meiofaunal populations in the intertidal zone of the Arabian Gulf: a persistent kill zone linked to elevated temperature

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In recent years the popular press has asked the question whether the sea surface temperatures in the Arabian Gulf are becoming too hot to sustain animal life. According to a climate modal published by Pal and Eltahir (2016), the hottest temperatures in the Arabian Gulf are likely to be seen in the area between Doha (Qatar) and Dhahran (Saudi Arabia). In order address this question, we are gathering baseline annual temperature data at several nearshore locations in Bahrain and Saudi Arabia. We measured seawater temperatures and substrate temperatures in the intertidal zone during the hottest time of the year at a lagoon in Askar, Bahrain. For the purpose of this study, we concentrated our attention on an exposed tidal flat that has a southward-facing slope. We additionally observed the distribution and behavior of marine benthic organisms in the intertidal zone. We repeated our observations every two weeks during the 2019 summer-autumn season.

The intertidal mudflat in Murray's Pool south of Askar (Bahrain) experiences summer temperatures in excess of 52°C at low tide on a hot summer afternoon. A "kill zone" with regard to meiofauna is observed on the mudflat where sediment temperature rises above ca. 40°C. In summer, a community of living foraminifera, gastropods, ostracods and diverse worms is only present in the tidal channels that contain water at low tide. Living foraminifera in the tidal channel mainly consist of the genera Ammonia, Peneroplis, and smaller miliolids. In the summer-autumn season of 2019, "summer" conditions persisted until the end of October. Temperatures below 40° were finally observed on the mudflat the first week of November. At this time, living juvenile Peneroplis specimens were observed on the surface of the mudflat. The site is currently being monitored on a bi-weekly basis to determine the length of the growing season.

We conclude that the intertidal faunas in Murray's Pool are thermally stressed, and the higher intertidal areas are already too hot to sustain benthic marine life during the summer-autumn season. This finding is in line with predictions of climate models, which foresee that portions of the

Arabian Gulf will become too hot to sustain animal life in the next decades.