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The effect of brine discharge from desalination plants on shallow marine ecosystems: Benthic Foraminifera as a case study.

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Desalination plants along the Mediterranean coast of Israel currently provide ∼587 million m3 drinking water/year, and their production is planned to increase to 750 million and 1.8 billion m3 drinking water/year by 2020 and 2050, respectively. A nearly equivalent volume of brine with a salinity of ∼80 is discharged into the shallow coastal water, where the normal marine salinity is up to 40. Brine-waste is often denser than the receiving environment, and therefore sinks and flows as a saline plume in adjacency to the sea floor where mixing is limited. The brine-waste and other desalination-associated discharged contaminants (such as anti-scalants, ferrous oxides and nutrients) can potentially impact marine ecosystems. Hence, the overarching goal of this study was to examine whether benthic foraminifera, which are known to be a sensitive marine proxy, are affected by this discharge. With this aim, the chronic effects of brine were investigated seasonally during 4 cruises between 2016 and 2017 near three operating desalination facilities along the Mediterranean coast of Israel, from south to north: Ashkelon, Sorek and Hadera. Sediment samples were collected in triplicates by grabs from the outfall (in immediate proximity to the discharge site), the brine-plume (where elevated salinity was measured in real-time) and an unimpacted reference station at each study site. Our results highlight that the most robust responses were observed when the brine was discharged along with other anthropogenic stressors (i.e. thermal stress of nearby power plants). The most common species (over 40% of the sample) found in the shallower stations at Ashkelon and Hadera (4 m water depth; high thermal pollution) are Ammonia parkinsoniana (Ashkelon and Hadera), and Pararotalia calcariformata (just Hadera), whilst the Sorek Station (20 m water depth; no thermal pollution) was characterized by the presence of Ammonia parkinsoniana, Ammonia tepida, Tretomphalus bulloides, Haynesina depressula, and the agglutinated Spiroplectammina sp. 1. The total foraminiferal abundance and diversity were, in most cases, lower near the outfalls, and increased towards the control stations. Changes in the abundance of selected species indicate their sensitivity to the brine-waste. For example, agglutinates with the organic cement species were present in very high numbers at the control stations, while at the outfall they were almost completely missing.