Seawater desalination chemical discharges impact coastal microbial communities of the eastern Mediterranean Sea.

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Seawater desalination plants increase local coastal salinities by discharging concentrated brine back to the sea, which also frequently contains chemicals including coagulants and anti-scalants (i.e. iron salts and polyphosphonates, respectively). We investigated the specific impacts of the chemicals utilized in the desalination process on coastal populations in experimental mesocosms treated with either iron ($FeCl_2$) or phosphonate ($C_9H_{21}N_3O_{15}P_5Na_7$), or a combination of both with increased salinities (15% above ambient). Iron addition induced rapid and significant increase in the heterotrophic cell specific activity (bacterial production normalized to bacterial abundance- BP/BA), while phosphonate addition caused immediate and significant reduction in the ecto-enzyme alkaline phosphatase activity (APA), i.e. immediately reducing P limitation. Rapid (within 2 h) synergistic effect was detected in the combined treatment, reflected by increased autotrophic activity (assimilation number- AN) and BP/BA, parallel to APA redaction. For the duration of the experiments (~9 days), iron addition caused significant decrease in autotrophic biomass and AN, probably by mechanical removal of the cells from the water (by aggregation). Phosphonate addition and the combined treatment increased the BP/BA parallel to decrease in P limitation. Positive correlations between AN and BP/BA were induced by phosphonate and combined treatments, implying of coupling creation between heterotrophic and autotrophic activities. This coupling may reflect bacterial dependence on dissolved organic carbon supply from the primary producers, indicating of altered microbial loop dynamic. Composition of prokaryotic and eukaryotic populations (16S and 18S) varied between treatments. Highest and significant shifts in beta diversity were detected in both prokaryotic and eukaryotic communities caused by the combination of the chemicals and salinity. Our results highlight the potential for iron and phosphonates combined with brine discharges to induce shifts in microbial communities in an ultra-oligotrophic environment such as the Levantine basin that may destabilize and change the local aquatic food web.