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Low diversity triggers harmful algae bloom (HAB) occurrence adjacent to desalination plants along the Red Sea

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ABSTRACT

Rapid, large scale growth of microscopic planktonic algae, called harmful algal blooms (HABs) have afflicted many marine coastal regions around the world. Few studies of HABs have been conducted in the Red Sea where desalination plants along the Saudi Arabian Red Sea coast provide drinking water for millions of people. We hypothesized that desalination effluent near the outlet of these desalination plants may alter the phytoplankton species composition and contribute to the selection of HABs in these areas. To test this hypothesis, a 2-year study from 2014 to 2016 was conducted to determine the diversity structure, spatio-temporal distribution and seasonal succession of phytoplankton populations using monthly samples from three different sites along the Saudi Arabian coast near Jeddah, Al-Shoaiba and Al-Quonfuduah. The results found a total of 125 phytoplankton species belonging to 4 major groups: Cyanobacteria (Cyanoprokaryonta) (*Oscillatoria* sp. and *Anabaena* sp.), Dictyocophyceae (*Dictyocha* sp.), Dinophyceae (85 species) and Bacillariophyceae (37 species). We identified high population percentages of the toxigenic species *Dinophysis miles* and *D. caudata* as well as the cyanobacteria *Anabaena* sp. The lowest diversity index (0.02 bits cell^{-1}) was detected on September 2016 at the Al-Quonfuduah near shore station during a bloom of *Nitzschia* sp. (4.4×10^5 cells L^{-1}). The lowest diversity detected at Al-Shoaiba in June 2015 (0.6 bits cell^{-1}) was during the proliferation of *Dinophysis miles* (7.2×10^4 cells L^{-1}). The highest diversity index (2.88 bits cell^{-1}) was detected at Jeddah during April 2016 due to the proliferation of 57 different species with equal concentrations. During the study period, Al-Quonfuduah had the most favorable conditions for the proliferation of toxigenic species and for overall numbers of microalgae taxa. The autumn period and nearshore stations had the most favorable conditions for phytoplankton among the three sites. Our results conclude that low phytoplankton diversity at the nearshore stations triggering an HAB occurrence may due to the high salinity and temperature of the desalination plant effluent.

Keywords: Desalination plants; Phytoplankton; Harmful algal bloom; Seasonal succession; Toxigenic species

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