POTENTIAL TOLL OF A DESALINATION PLANT: B) THE MICROBIAL ASPECT

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Abstract

The potential impact of backwash and brine discharge on the standing stocks and productivity of phytoplankton and bacterioplankton was monitored at the area of the outfall of a reverse-osmosis based desalination plant. Preliminary results indicate that the backwash, that includes iron hydroxide used as a coagulant, may have a potentially inhibitive impact on the microbial biota found near the outfall.
Keywords: Chlorophyll-a, Bacteria, Levantine Basin, Primary Production

Three surveys (April and August 2008 and April 2009) were conducted in the area of a brine outfall of the desalination plant in Ashkelon, Israel. The water quality aspect is described by Dromi et al (Submitted abstract, CIESM 2010) and the current presentation relates to the possible impacts of the brine outfall on phytoplankton and the bacterial community. Although one may assume that brine by itself is diluted rapidly and does not leave a detectable impact even of sessile organisms [1], the discharge of a coagulants and antiscalants (added for the amelioration of seawater prior use in the plant) poses potentially a stress factor for biota. Water samples were collected before, during and after the pulsed discharged of the backwash, along a gradient from the more affected area to apparently clear (non affected) water area. It should be emphasized that brines from the desalination plant and the cooling water from the power station located at the same site were discharged continuously and only the backwash discharged was pulsed. Phytoplankton standing stock was assessed by the measurement of chlorophyll *a* (Chl) concentration and primary productivity by ^{14}C-labeled bicarbonate uptake under standard conditions of 20 ºC and light flux of 100 mmol photon m^{-2} s^{-1}. Chl in the unaffected area was 1-2 mg m^{-3}, but as low as 0.15 mg m^{-3} following the discharge of the backwash. Most of the algal biomass was composed of cells larger than 10 micron in diameter, and microscopic qualitative examination revealed that diatoms and dinoflagellates dominated phytoplankton. Comparison of acidified and non-acidified Chl extracts showed phaeophytin (and Chl degradation products) constituted only a small fraction of chlorophyllous pigments, and thus we may assume that most phytoplankton cells collected from the sea samples were intact, indicating that physical damage was not part of water treatment impact. Chl-normalized photosynthetic activity ranged from 1.1 to 6.8 mg C mg Chl^{-1} $h^{-1}$and showed a trend of inverse relationship with the proportion of the coagulant in seawater (Fig. 1). The latter was assed by reddish hue imparted by the presence of iron hydroxide and determined by spectrophotometric examination of the sea water at 400 nm.

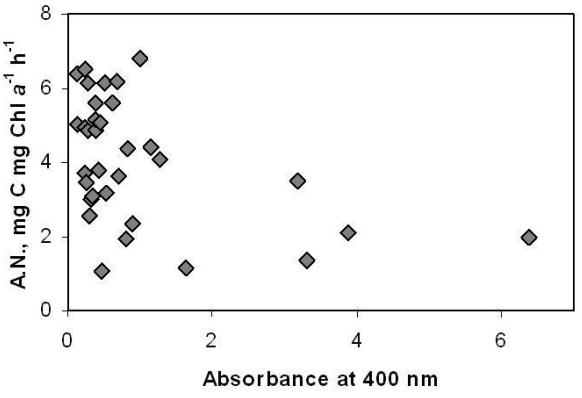

Fig. 1. Plot of assimilation number (A.N.), which is the expression of chlorophyll *a*-based value of primary productivity, against absorbance at 400 nm determined spectrophotometrically.

Bacterial counts were conducted in DAPI stained sub-samples. Bacterial density was also inversely correlated with the distance from the outfall and time elapsed since the backwash discharge, and varied from 1.8 and 41.1*10^8 cell L^{-1}. Cell number-normalized bacterial productivity, measured under standard conditions by ^{14}C- labeled leucine, increased from the outfall site towards clear water, approximately proportionally to the manner seen in the biomass-based phytoplankton productivity. Rates of algal and bacterial productivity were positively correlated, however the relationship between the rates changed between experiments (Fig. 2).

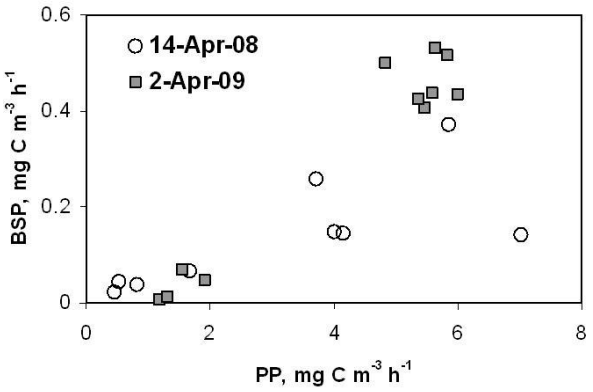

Fig. 2. Comparison of the rates of primary productivity (PP) and bacterial secondary productivity (BSP) offshore the desalination plant offshore Ashkelon, Israel.

While the spatial trend of increase of standing stocks of phytoplankton and bacteria towards the clear, unaffected water indicate, probably, just the dilution impact of the backwash discharge from the desalination plant, modification of rates is apparently a display of the inhibitive role of the saline concentrate and/or accompanying chemicals on microbial physiology. However, further investigation is required to elucidate: 1) what is the mode of action of the components of the backwash discharge, and 2) does the inhibitive action of the backwash water confers a risk of modification of the planktonic microbial community in the area of discharge on the long run.

References

1 - Raventos N., Macpherson E. and Garcia-Rubieis A., 2006. Effect of brine discharge from a desalination plant on macrobenthic communities in the NW Mediterranean. *Marine Environ. Res*., 62:1–14.