THE EFFECT OF WELL-AMELIORATION BRINE ON COASTAL MICROBIAL POPULATIONS IN THE SE MEDITERRANEAN SEA

Ofrat Raveh [1], Dror Angel [2] and Eyal Rahav [1]*
[1] Israel Oceanographic and Limnological Research - eyalrahav@gmail.com
[2] Department of Maritime Civilizations, Leon Recanati Institute for Maritime Studies, Haifa University, Haifa, Israel.

Abstract
This study investigates the role of well amelioration brines (WAB) on phytoplankton and heterotrophic bacterial abundance and production rates in the coastal SE Mediterranean Sea (SEMS) water - one of the most oligotrophic marine environments in the world. For that, we manipulated surface SEMS with N or WAB using mesocosms during summertime. Our results demonstrate that once added with N-rich additives, autotrophic biomass and production immediately increases, suggesting they are N limited. This is opposite to the open SEMS where autotropic microbes are co-limited by N and P. Contrary to autotrophs, heterotrophs remained unchanged; suggesting they are limited by other chemical constitutes than N. This information is essential to better understand the impact of nutrient loads from land-based sources in this oligotrophic environment.

Keywords: Primary production, Bacteria, Nutrients, Levantine Basin

Introduction
The Israeli Mediterranean coastal waters are characterized by low nutrient and chlorophyll levels (Raveh et al., 2015). Anthropogenic inputs of nitrate-rich well-amelioration brines (WAB) may greatly affect microbial populations by altering the community composition, production rates, nutrients recycling, etc. and hence the ecology of the coastal waters. In this study, we conducted several mesocosm (1-m^3 tank each) experiments that examined the short to medium term effect(s) of nitrate and WAB on ambient coastal SE Mediterranean Sea waters.

Material and Methods
Acid-washed polyethylene bags (1-m^3) supported by cylindrical plastic frames were deployed within a continuously circulating seawater to maintain ambient temperature of the experimental water during July 2015. Surface (2 m deep) coastal seawater from Haifa (Israel) was pumped and distributed homogenously between the mesocosm bags. Seawater was sampled for algal biomass (Welschmeyer, 1994), heterotrophic bacterial abundance (Vaulot and Marie, 1999), primary production (Steemann-Nielsen, 1952) and bacterial production (Simon et al., 1990).

Results and Discussion
Our results show that both the autotrophic populations and the primary production rates were significantly enhanced by the addition of either nitrate alone or WAB (Figure 1A,B, $P<0.05$), corresponding to the nitrogen-limiting conditions. Contrarily, the heterotrophic bacterial abundance and production rates were, overall not affected by any of these supplements (Figure 1C,D, $P>0.05$), suggesting that other limiting factors affect bacteria in this coastal system, possibly trace elements (Fe, Al, Cu), carbon, or the simultaneous limitation of several components. Lastly, the current ongoing and future plans for the expansion of brackish groundwater desalination will result in significant nitrogen loads along the coast. The results of this study will enable us to apply a better, science-based environmental policy.

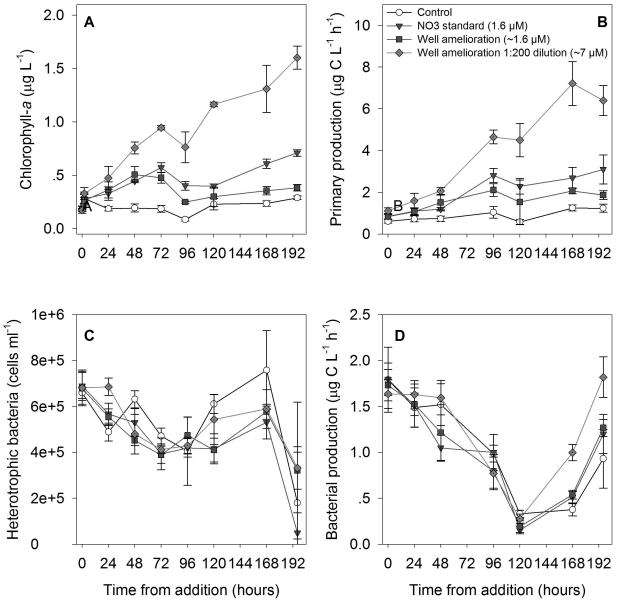

Fig. 1. Temporal changes in autotrophic biomass (A), primary production (B), bacterial abundance (C) and bacterial production (D) following the addition of well amelioration brine during July 2015.

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