THE DISTRIBUTION AND THE PROTOZOAN GRAZING EFFECT ON THE SURVIVAL OF BACTERIOLOGICAL INDICATORS OF POLLUTION AT DISCHARGE POLLUTED MARINE SEDIMENTS

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Abstract
The monthly distribution of indicator bacteria were studied at the Black Sea exit of the Strait of Istanbul. The fecal coliform counts were lower than the fecal streptococci indicating that most of the culturable fecal coliform were lost. According to the sediment assays, the sediment microbiota consumed over 50 % of the fecal coliform and fecal streptococci. Although *C. perfringens* was also consumed by the predators, the counts during incubation period remained rather constant. According to these results, *C. perfringens* should be included to the sediment pollution monitoring studies since it has the highest survival rate.
Keywords : Bacteria, Bosphorus, Sewage Pollution, Sediments.

Introduction
The bacteriological indicators of water column pollution are generally used for estimating the sediment pollution [1], [2], [3]. The most common bacteriological indicators are fecal coliform and fecal streptococci [4] and *Clostridium perfingens* [5]. There are many deep discharge points through the Strait of Istanbul and therefore the lower current flow carry wastewaters to the Black Sea exit most of the year [6]. Studies showed that the macrobenthic diversity was adversely affected by discharging of wastewaters without any treatment in the Marmara Sea [7].
Material and Methods
The distribution of fecal coliform, fecal streptococci and *C. perfringens* at the sediment of the northern exit of the Strait of Istanbul was studied for twelve months. The sediment samples were diluted by sterile seawater and sonicated as described [2]. For the estimation of the survival of bacteria, the sediment samples were incubated in 1 L jars with filtered (1.2 μm) and non-filtered sediment surface water of the station and sterile seawater for control at 20 C° for seven days. The bacterial survival was detected by sampling form the incubation jars every 24 hours.
The fecal coliform counts were lower than the fecal streptococci counts throughout the year. The spores of *C. perfringens* were lower than the total *C. perfringens* counts, however, the number of spores were close to that of total *C. perfringens*.

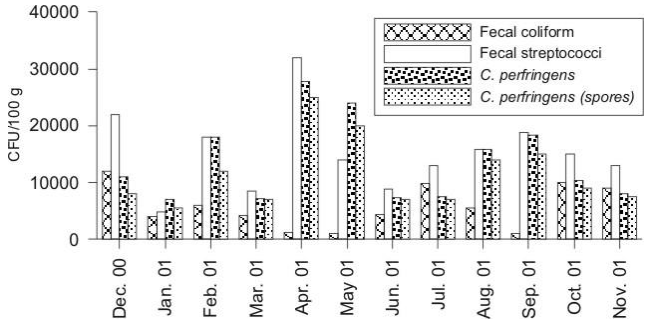

Fig. 1. Distribution of indicator bacteria throughout the study.

The survival ability of fecal coliform was the lowest of all groups studied both in the filtered and non-filtered seawater. The fecal coliform counts decreased in non-filtered assay from 80000 CFU/100 g to 600 CFU/100 g within 7 d. Fecal streptococci also decreased remarkably from 100000 CFU/100 g to1800 CFU/100 g. Both fecal coliform and fecal streptococci counts were higher in filtered assay at the end of the first day. The fecal coliform decreased from 100000 CFU/100 g to 1000 CFU/100 g and fecal streptococci decreased from 230000 CFU/100 g to 10000 CFU/100 g after 7 d. According to the data of the first three days, 70 % of the initial fecal coliform and 50 % of the initial fecal streptococci was lost in non-filtered samples. Besides, the cells were lost more slowly at the filtered samples (20%). The size selective grazing as described [1], might be the result of a more rapid decrease in fecal coliform compared to other indicators. Although the *C. perfringens* counts were higher in the filtered samples, the vegetative and spores counts remained rather constant in both assays throughout the study.

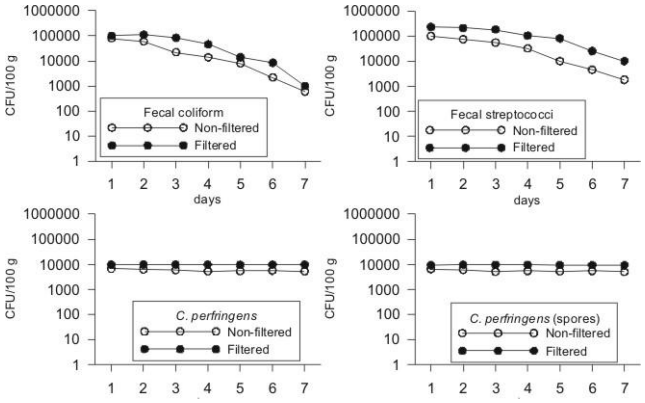

Fig. 2. Survival of indicator bacteria in the marine sediment.

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