LAND BASED AND SHIP ORIGINATED POLLUTION IN THE TURKISH STRAITS SYSTEM

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Abstract
Until the early 1970's the Turkish Straits System was one of the richest and most productive marine environments in the world [1]. Due to pollution stemming mainly from land-based pollution and maritime traffic, this sensitive ecosystem is now facing the threat of degradation.
Keywords: Marmara Sea, Bosphorus, Pollution

Introduction
It has been estimated that on a global scale, up to 70% of pollution in the seas originate from land-based sources [2]. The marine environment of the Marmara Sea has become increasingly vulnerable; whose oceanographic features do not help much its self-purification capacity. This inland sea is a semi-enclosed water body of 11111 km^2 with an average depth of 260m connecting the Mediterranean and the Black Sea via the Canakkale (Dardanelles) and Istanbul Straits. Domestic pollution load is generated mainly by the Istanbul Metropolis and its surroundings where 1/5 of Turkey's population live [3]. Furthermore large industrial facilities amounting to 60 % of the total, located on the bays and coastal areas constitute the most significant portion of local land-based input into the Marmara Sea. Additionally the marine environment of the Istanbul Strait and Marmara Sea is confronted with severe environmental degradation due to ship-originated pollution generated mainly by the bilge/ballast waters of tankers and cargo vessels.

Material and Method
The study was carried out in the Istanbul Strait and Marmara Sea (Figure 1). The water quality monitoring sampling frequency of the Istanbul Strait was designed to monitor the sea water quality on a monthly basis at the monitoring stations, whereas the Marmara Sea stations were followed on seasonal basis for a comprehensive set of parameters enabling the identification of the physical, chemical, biological state of the marine environment for all the stations.

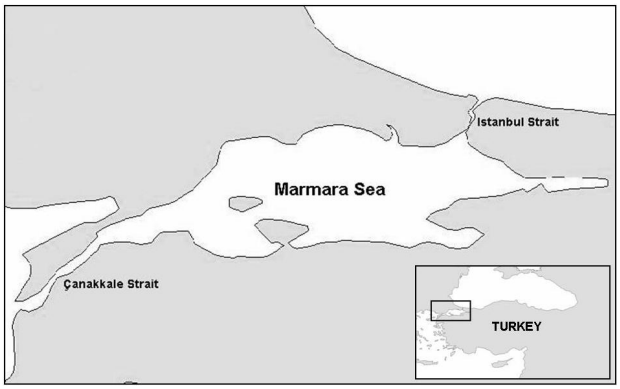

Fig. 1. Study area

Results
The land-based pollution load for the Marmara Sea generated by major hotspots was calculated during the compilation of the Istanbul Master Plan study. DHI found out that the major hot-spots is Istanbul (contributing with almost 65% of the total land-based pollution to the Marmara Sea) [4]. The Marmara region is the most developed in terms of industrialization, with a wide variety of industries concentrated in the Gulf of Izmit, Gemlik and around Istanbul. The build-up effect of pollution has started to spread over the continental shelf, giving rise to a widespread deterioration of the natural balance in the marine ecosystem. Difficult natural conditions such as the intricate geometry of the Istanbul Strait, sharp turns on the navigation route, harsh meteorological conditions and transient changes in the flow regime coupled with increasingly dense maritime traffic create a serious risk of accident. Significant amounts of crude oil spill have been the major cause of ecological damage experienced so far as a consequence of maritime accidents. The ecological hazard generated by oil spill has resulted in the decrease and/or extinction of surface and subsurface fish species and crustaceans.

Discussion
The experimental results of a ten-year monitoring, study from the year 1996 to the year 2005, indicates an improvement with regard to nutrient load in the surface waters of the Marmara Sea after the commissioning of the deep-sea outfalls. But there is still incremental and point source pollution in the Marmara Sea with high phytoplanktonic activity. Therefore, pollution is still a concern for the receiving waters of Istanbul and in the Marmara Sea basin in general despite large investment expenditures allocated to Istanbul [5,6]. The accidents caused by tankers and cargo ships resulting in loss of human life, property and damage to the environment have been creating great public concern. Pollution derived from the maritime traffic in the Istanbul Strait and Marmara Sea is no exception. Besides sea accidents, illegal practices such as pumping of bilge and waste water, and unloading of dirty oil and garbage by transit vessels in particular, contribute to marine pollution, which also affects recreational beaches [7].

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