# AN INVESTIGATION ON THE MAJOR SEWAGE OUTFALL IN MALTA

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The coastal zone of densely populated island states like Malta are often threatened by environmental hazards resulting from the discharge of untreated sewage or wastewaters into the marine environment. This paper reports on the first full investigation on the major sewage outfall in Malta. This is located at Wied Ghammieq on the north eastern coast of the island (Fig. 1), where 80% (approx. 40,000 $m^3$ per day) of the total urban and industrial wastewater in Malta is discharged untreated through a 700 m long outfall pipe. The pipe ends in a diffuser at a depth of 36 m. In order to determine the extent and direction of the resultant sewage plume under different hydrographic conditions, several water parameters were monitored at various depths over a period of one year (1991-1992) when the submarine outfall was fully operational. Water currents were measured at various depths using drogues. The same survey was repeated more recently (June 1994) while the outfall was not functioning properly and the sewage effluents were being discharged directly from the shoreline.

Water stratification was evident during summer with a thermal step of 2.4°C being present at 25 - 30 m depth, probably leading to subsurface jet trapping at a depth where the density of the hyposaline jet is equivalent to that of the water column. The bottom plume could also be detected by reduced water temperatures at the bottom near the outfall.

When the submarine outfall was operational, water visibility near the outfall was low (e.g. Secchi depth: 1.5 m) but rapidly improved with distance away from outfall reaching background levels. Anoxic or hypoxic conditions were never evident throughout the water column. Nitrate levels were generally low, a maximum of 3.31 ug-at N/l being reported only near the outfall. Phosphates however were quite high near the outfall, the highest being 4.39 ug-at P/l, which is far above the 1.5 ug-at P/l given by HUNTER and RENDALL (1986) to be the limit above which water is considered polluted. Levels however decrease rapidly with distance to background values (0.06 ug-at P/l). N/P ratios show that the region under investigation generally exhibits optimum assimilatory proportion for the two nutrients, except for the region in the immediate vicinity of the outfall where nitrogen was limiting.

Surfactant levels were very low, the highest level being 0.076 mg/l which is below the 0.1 mg/l level expected in the vicinity of a sewage outfall (APHA 1985), and decreased with distance from the outfall. Total coliforms (TC) at surface were low, being well below the 100 CFU/100 ml limit for clean waters given by the EC. Levels in faecal coliforms (FC) in the vicinity of the outfall showed that the level of dilution of the sewage plume being achieved in the area is very high. Phytoplankton counts decreased rapidly towards the vicinity of the outfall. The species composition also varied so that *Skeletonema costatum* and other centric diatoms were the dominant forms nearest to the area under the influence of the discharge, with dinoflagellates being absent.

The mean surface current velocity near the Wied Ghammieq outfall was generally close to 0.21 m/sec. Deeper currents were slower, generally at half the surface current values, and were in most cases not directly influenced by wind direction.

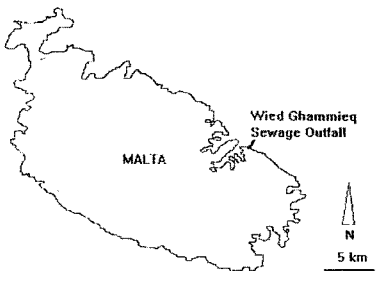
During the more recent survey, the sewage effluents were being discharged directly onshore due to a malfunctioning of the submarine outfall. A highly visible plume extended out at sea to an approximate distance of 100m. The plume was directed along the coast towards the south-east. In this case, the direction of surface sea currents was along the shore towards the SE with a mean speed of 0.31 m/sec.

The highest reported levels of TC (above 10 000 colony forming units/100 ml) were those within the plume itself at approximately 1300 m away from the discharge point. Relatively high levels of TC were also recorded along over 5 km of coastline, both at the surface and in the bottom waters. Highly contaminated waters carrying more than 1000 FC CFU/100ml extended up approximately 2 km away from the original discharge point. Such levels are above the national guidelines for bathing waters.

To conclude, the present study showed that the fast water currents as well as the design and location of the outfall should provide a very good dilution of the discharged effluents, when the submarine outfall is fully operational. However taking into account the reported levels of nutrients, water visibility and other indicator parameters, it may be estimated that during periods of onshore currents, approximately 5 km of coastline may be under the influence of this discharge. On the other hand, when the submarine outfall is not operational and the wastewaters are being discharged onshore, the microbiological contamination of the coast extends up to 5 km from the discharge point rendering the whole area unfit for bathing.

This study was a preliminary investigation to assess the geographical extent of the sewage plume discharged by this outfall. It is the first stage of a longer-term project aimed at assessing the environmental impact of local sewage outfalls and at providing the necessary background information for a master sewerage plan for the island.

Fig.1 Location of the major sewage outfall in Malta

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# THE STATE OF *POSIDONIA OCEANICA* (L.) DELILE MEADOWS IN THE MALTESE ISLANDS (CENTRAL MEDITERRANEAN)

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We have assessed the state of local *Posidonia oceanica* meadows by considering spatial and bathymetric distribution, general health, and plant morphological characteristics. Our results show that dense and healthy meadows cover large areas of bottom off the Maltese coasts and extend to considerable depths, in places down to 43 m. At some sites where there is a strong anthropogenic influence, *Posidonia* meadows have regressed or been killed off altogether.

Data on the spatial and bathymetric distribution and on phenology of *Posidonia* meadows in the Maltese islands is lacking, even though dense beds of this seagrass cover large areas of bottom off the islands' coasts. The only information available on the spatial distribution of *Posidonia* meadows is that presented by ANDERSON *et al.* (1992) in the form of a map of the benthic communities around the Maltese Islands; DREW & JUPP (1976) give the only local data on growth and morphological parameters of this seagrass. The aim of our research is to assess the state of *Posidonia* meadows in the Maltese Islands in order to establish a baseline against which to compare future work.

The spatial extent of *Posidonia* meadows around the Maltese Islands was mapped using standard SCUBA diving techniques. Because of this, our data is limited to the depth of safe diving, in practice about 45 m (Fig. 1). Typically along the coasts of Malta, *Posidonia* first occurs as patchy stands at a depth of around 5 to 6 m and continues as dense meadows down to depths of 25 to 30 m on soft sediment. It is only in the more sheltered bays and inlets that continuous meadows are found in very shallow water (1 to 3 m). The Malta-Comino and Comino-Gozo Channels (Fig. 1) have particularly dense and healthy meadows. In March 1994, we discovered a healthy *Posidonia* meadow at a depth of 43-44 m at Wied Ternu, off the southwestern tip of Comino island. Three 0.125$m^2$ quadrats were used to estimate the shoot density. This varied between 125 and 155 shoots/$m^2$. The mean number of leaves per shoot was 4.2 (n = 10), while the mean length of the leaves (based on intermediate and adult leaves) was 14.4 cm. The leaf width was between 8.5 and 9.5 mm. We are aware of only a few records of *Posidonia* meadows growing at such depths in the Mediterranean (for example, MEINESZ *et al.*, 1988; BOUDOURESQUE *et al.*, 1990).

In other parts of Malta, such as at Mellieha Bay, frequent anchoring of pleasure boats is probably the main factor causing significant damage to the extensive *Posidonia* meadows originally present, as shown by an increase in the size and number of "intermatte" areas in the bay. Two *Posidonia* barrier reefs have been discovered in this bay, and another in the nearby Salina Bay.

In several bays and creeks where harbours are located, *Posidonia* meadows have regressed and have been totally replaced by pollution-tolerant benthic communities characteristic of such environments (for example, Marsamxett and Grand Harbour). At Pretty Bay, Birzebbuga, dumping of large amounts of sediment dredged from the seabed and pumped onshore to create an artificial beach, buried and killed most of the seagrass meadows in the area when it was subsequently moved offshore by wave action and currents (BORG & SCHEMBRI, 1993). At Mistra Bay and Mellieha Bay, offshore fish farming operations have caused regression of *Posidonia* meadows located under the fish cages.

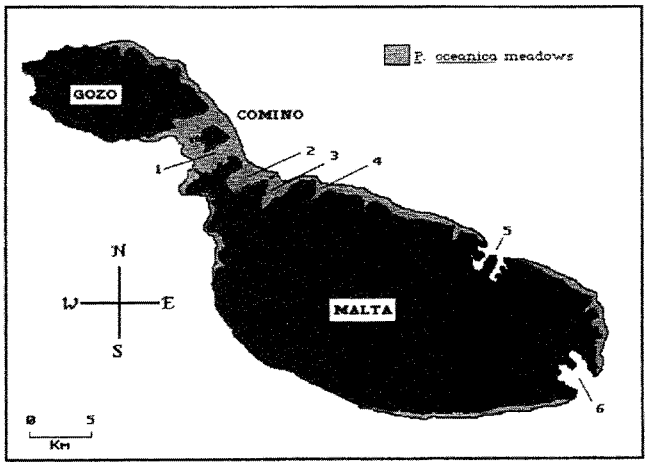


Fig. 1: Small scale map of the Maltese islands showing the spatial distribution of *P. oceanica* meadows, and localities mentioned in the text: 1 Wied Ternu, 2 Mellieha Bay, 3 Mistra Bay, 4 Salina Bay, 5 Marsamxett and Grand Harbour, 6 Pretty Bay.

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