Eutrophication Monitoring in Malta (Central Mediterranean)

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No comprehensive reports about environmental conditions which may lead to coastal eutrophication in Malta have been made as yet. Two main harbours which were investigated, lie on the NE coast of Malta (figure 1) and are situated in the most densely populated part of the main island. The **Grand Harbour** includes Malta's major ship yards, a tank cleaning facility and a power station located at its innermost part. Most of the harbour is approximately 10-20m deep **Marsamxett harbour** is deeper, reaching depths of 30 m in its central region. It surrounded by touristic localities, including a recently developed yacht marina and a yacht repair yard.

The paper reports on data collected during a 3-year programme (1989-1991) where several parameters, including phosphates, nitrates plus nitrites and chlorophyll A levels (measured according to PARSONS *et al.*, 1984), were monitored at 14 fixed stations. **Table 1** summarises the data on some parameters at a selection of such stations (data on all stations will be given in the full text of the paper). Surface temperatures in the Grand Harbour were generally higher than those at Marsamxett or the reference station, with peak values being recorded close to the power station. Water stratification durring the summer months was evident in all stations. Salinity fluctuations were minimal except at the innermost stations at Marsamxett, with minima of 16.4 and 34.4 ppt being recorded after heavy rainfall. No anoxic conditions were ever reported in bottom waters though minima ranging from 3.3 to 4.8 ppm were sometimes recorded in the bottom waters of the inner creeks at Marsamxett and Grand Harbour.

The transparency of the waters decreased significantly from the reference station towards the innermost parts of both harbours where minima ranging from 1.2 m to 1.8 m were recorded in various months. The degree of correlation between chlorophyll A contents and water transparency was found to be low, indicating that much of this reduction in water transparency is due to inorganic suspended matter released into the water column as a result of dredging activities in both harbours. Nutrient levels at the reference station were generally typical of coastal inshore waters, though on some occasions, very high levels of phosphates (4.7 µg-at P/l) and nitrates (24.2 µg-at N/l) were recorded here. Though this happened quite rarely, it shows that this station was sometimes under the influence of the nearby major sewage outfall at Wied Ghammieq (Figure 1) which is approximately 2 to 3 km away on the eastern side of the Grand Harbour. On the whole, nutrient levels were generally higher in Marsamxett than in Grand Harbour. Particularly high levels of phosphates (eg. 7.6 µg-at P/l) were found in Marsamxett during dredging activities, and this may be one of the major factors contributing to elevated nutrient levels in this harbour. Nitrate (plus nitrite) maxima ranging from 22 to 45 µg-at/l were also more frequently reported here, being comparable to nitrate levels reported from highly eutrophic areas such as Elefsis Bay, Greece (eg. FRILIGOS, 1988).

Chlorophyll A levels in most stations in Marsamxett were generally higher than those from the Grand Harbour with maxima ranging from 2.4 to almost 9 µg/l being recorded especially from October to January. These levels were found to be well correlated with phosphate and nitrate levels, with correlation coefficients of 0.399 and 0.385 being reported, respectively (both significant at the 1% level). Levels of chlorophyll A were generally uncorrelated with water transparency. This again points out that any reduced water transparency was mostly due to the increased occurrence of suspended matter in the water column. Surprisingly enough, levels of chlorophyll A in the innermost stations at Grand Harbour were generally quite low in spite of the elevated nutrient levels (as well as high ambient temperatures). This shows that some limiting factor(s) other than availability of nutrients must be affecting productivity within this area.

In conclusion, while nutrient levels were in some cases comparable to other coastal Mediterranean regions which have exhibited evident signs of eutrophication, primary productivity as monitored by chlorophyll A contents was never significantly high. Most of the nutrient loads were probably derived from dredging activities in the areas. Whether these elevated nutrient levels may eventually lead to hyperproductivity and algal blooms, and if so, what would be the factors which may trigger this effect, are two questions which still need to be answered by the present on-going environmental monitoring programme which is being conducted in the area. The present study has also shown that one major impact on the local coastal water characteristics, is the thermal emissions of the present power station in the Grand Harbour. The nature and spatial extent of the associated environmental impact still need to be determined.

Table 1: Mean values (9 replicates) and ranges of some selected parameters at surface (s) and bottom (b) waters at some of the stations shown in Figure 1, for Marsamxett (MX) and Grand Harbour (GH) during 1989-1991. All data on all stations will be presented in the full text.

	Station:	MX1s	MX1b	MX3s	MX3b	Ref.s	Ref.b	GH13s	GH13b	GH14s	GH14b
Secchi Depths	Mean:	3.6		4.0		11.7		2.7		2.6	
(m)	Max:	5.8		6.0		14.3		3.8		4.0	
	Min:	2.0		1.2		6.0		1.6		1.8	
Phosphates	Mean:	1.5	1.1	1.6	1.1	0.7	0.1	0.6	0.6	0.8	0.7
(µg-at P/l)	Max:	2.8	2.6	5.5	4.2	4.7	0.2	1.3	1.3	2.9	3.5
	Min:	0.1	0.1	0.1	0.1	0.0	0.0	0.1	0.1	0.1	0.0
Nitrates/	Mean:	26.4	13.6	17.8	19.8	9.9	13.9	13.5	12.1	14.9	16.3
Nitrites	Max:	45.0	26.8	36.6	43.2	24.2	28.7	27.4	23.7	28.9	25.5
(µg-at N/l)	Min:	10.8	3.1	2.0	1.0	2.1	4.4	2.8	1.2	2.8	1.6
Chlorophyll A:	Mean:	1.6	1.9	1.6	2.0	0.6	0.3	1.0	0.8	0.7	0.6
(µg/l)	Max:	4.2	7.1	5.3	5.8	1.8	0.7	2.7	2.3	2.1	1.7
	Min:	0.1	0.1	0.2	0.1	0.1	0.0	0.2	0.3	0.0	0.0

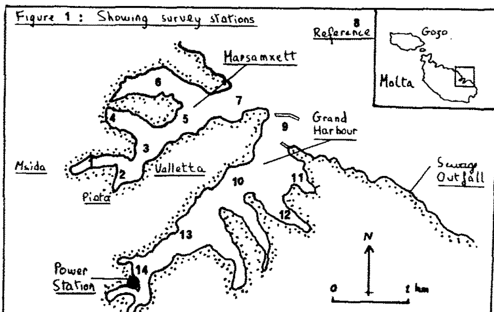

Figure 1 : Showing survey stations

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