Occurance of low salinity water in Mahim Bay

1 BACKGROUND

On 19 August 2006 the water in the near-shore zone of the Mahim Bay in the vicinity of Shivaji Park was reported to have turned fresh water. The strange news resulted in public frenzy with thousands of people visiting the beach, many of whom not only bathed in the water but also drank it with the faith that a miracle had occurred. Hence, it was of considerable scientific interest to identify the source of this low salinity water and offer plausible reason for this phenomenon. This report is based on the studies conducted by the National Institute of Oceanography (NIO) in the Mahim Bay on 19 and 21 August 2006.

2 AREA DESCRIPTION

Differential weathering of the inter-layered soft tuffs and resistant basaltic flows (Deccan Traps) by seawater has created several bays and creeks around Mumbai; the prominent among them being the Thane Creek-Mumbai Harbour and the Mahim, Versova and Bassein Creeks. The semi-enclosed Mahim Bay that provides shelter to fishing crafts is open to the Arabian Sea on the west and connected to the Mahim Creek on the north-east (Figure 1). The northern shores of the Bay are predominantly rocky with mud-patches in-between, while, the central and the southern zones are largely sandy with occasional rock outcrops. Mahim Creek which is wide and shallow is the inland extension of the Mahim Bay separated by a narrow constriction at the Mahim Causeway. The Mahim Creek receives overflow of the Vihar and the Powai Lakes during monsoon via the Mithi River. The average fresh water flow of about 85 m^3/s during August has been reported in the Mahim Bay though during periods of high precipitation in the catchment, abnormally high river discharge can occur in the Bay. The runoff decreased considerably after the withdrawal of monsoon leading to stagnant conditions in the Mithi River and the Mahim Creek after September and the system resembled an effluent drain (Zingde and Desai, 1980; Sabnis, 1984; Zingde and Sabnis, 1994). Mahim Creek sustains vast stretches of mangroves, which in places have been degraded severely due to the pressure of development.

The high terrestrial runoff during June-September (monsoon period) associated with heavy precipitation causes annual flushing of the inshore areas thereby substantially improving their ecological quality.

3 STUDIES CONDUCTED

Shore sampling was done to the East of station 1 on 19 August 2006 between 1210 and 1630 h. A total of 10 samples were collected over a length of about 1 km of the shore with station 1 as the centre.

On 21 August 2006, the samples were collected during flood and ebb tides at all stations marked in Figure 1. The high tide and low tide occurred around 1110 and 1730 h respectively at Bandra, on the day of the sampling. Water samples were obtained at the surface and bottom wherever depth exceeded 2 m, otherwise, only surface samples were collected. The pH was recorded immediately after collection, while, other parameters namely salinity, dissolved oxygen (DO), ammonium-nitrogen (NH_4^+-N), phosphate-phosphorus (PO_4^{3-}-P), nitrite-nitrogen (NO_2^--N) and nitrate nitrogen (NO_3^--N) were analysed in the laboratory of NIO at Andheri on the same day of collections. One shore sample collected in the early morning of 19 August 2006 was made available for analysis by the Mahim Police Station. All samples were analyzed using internationally accepted procedures. Samples from selected stations were also obtained for examination of phytoplankton, zooplankton and macrobenthos. These analysis are in progress.

4 MAHIM BAY ENVIRONMENT

The results emerging from samples analysed are presented in Tables 1 to 3 and illustrated graphically in Figures 2 and 3. Analysis of phytoplankton, zooplankton and macrobenthos are in progress. These results will be included in the final report.

a) pH:

The principal systems that regulate pH of water are the carbonate system consisting of CO_2, H_2CO_3, HCO_3^- and CO_3^{2-}. Because of the buffering capacity of seawater, generally seawater pH has limited variability (7.8 – 8.3). In shallow, biologically active tropical waters, large diurnal pH changes - from 7.3 to 9.5, may occur naturally because of photosynthesis. In the nearshore and estuarine systems influx of freshwater, particularly during monsoon, can affect the buffering effect and the pH often remains below 8.0. These areas are also vulnerable to pH changes due to release of anthropogenic discharges.

The pH of the Mahim Bay varied from 7.5 to 8.0 and was in the range expected for coastal water of Mumbai (monsoon) with the majority of values between 7.6 and 7.7 perhaps due to the influence of land runoff and high microbial activity in the Bay.

b) Salinity:

Salinity is an indicator of freshwater incursion in coastal waters as well as excursion of seawater in inland water bodies such as estuaries, creeks and bays. Normally seawater salinity is 35.5 ppt which may vary depending on evaporation, precipitation and freshwater influx. Thus for instance, during premonsoon evaporation exceeds precipitation leading to salinities higher than 35.5 ppt, while, during monsoon and postmonsoon the salinities can be markedly lower.

The overall salinity in the Bay (1.0 - 19.9 ppt) though varied widely was markedly lower than expected (Zingde and Desai, 1980) in the Arabian Sea off the mouth of the Mahim Bay (25 - 30 ppt) during monsoon. The salinity between the surface and bottom varied considerably with a trend to increase during flood tide and also in the direction of the sea (Figures 2 and 3).

c) Dissolved oxygen:

DO is of considerable interest in water quality investigations as its concentration in water is an indicator of ability of a water body to support a well balanced aquatic life. DO in water is replenished through photosynthesis, dissolution from the atmosphere and addition of oxygen-rich water such as through runoff. Simultaneously, DO is consumed during heterotrophic oxidation of organic matter and respiration by aquatic flora and fauna as well as oxidation of some naturally occurring constituents in water. Thus, equilibrium is maintained between consumption and replenishment of DO. In natural waters the rate of consumption of DO is lower than the rate of replenishment resulting in maintenance of adequate concentrations which are often at the saturation level. Influx of anthropogenic discharges containing oxidizable matter such as sewage and certain pollutants consume DO more than that the water body can replenish creating under-saturation which, in extreme cases, may lead to onset of septic conditions with mal-odorous emissions thereby degrading the ecological quality.

The DO was markedly high in samples of 19 August 2006 and decreased to low values in many instances in samples of 21 August 2006. Two distinct characteristics were evident from the scrutiny of data in Figures 2 and 3. As in the case of salinity, the DO was distinctly high in the bottom water on several occasions unlike in unpolluted natural seawater wherein the trend is generally reverse. Secondly, the DO in the Bay was often low during ebb tide particularly at stations 1 and 2. In line with salinity, the DO increased in the seaward direction (station 1 to station 3) with extremely low values (0 - 0.7 ml/l) at station 4 that was fed by the outflow of the Mahim Creek. The DO was also low (0.4 - 2.9 ml/l) at station 5 during low tide though increased substantially during flood tide (3.8 - 4.0 ml/l). The DO was relatively high (3.4 - 4.9 ml/l) in the southern Bay (station 6) during flood as well as the ebb tide.

d) Phosphate-phosphorus (PO_4^{3-}-P):

Dissolved nutrients, though in low concentrations, are essential for the production of organic matter by photosynthesis. Among several inorganic constituents such as phosphate, nitrogen compounds, silicate, trace metals etc, the traditional nutrients namely phosphate and nitrogen compounds have a major role to play in primary productivity. However, their occurrence in high levels in areas of restricted water exchange such as creeks, bays and estuaries can lead to an excessive growth of algae which in extreme conditions result in eutrophication. Anthropogenic sources of phosphate in coastal marine environment include domestic sewage, detergents, effluents from agro-based and fertilizer industries, agricultural runoff, organic detritus etc. Domestic sewage contributes substantially to phosphate enrichment around urban settlements such as Mumbai where marine disposal of sewage is the preferred option.

The concentration of PO_4^{3-}-P in the Mahim Bay varied in the range (3.6 – 46.8 µmol/l) with a definite trend (Figures 2 and 3) of decrease in the seaward direction (station 1 to station 3). The bottom water with relative high salinity invariably had low concentration of PO_4^{3-}-P. The highest concentration (46.8 µmol/l) was recorded at the surface at station 5 which was off the mouth of the Mahim Creek and the lowest (3.6 µmol/l) at the Bay mouth (station 3) in the bottom water. Typical concentration of PO_4^{3-}-P in the coastal water of Mumbai is <3 µmol/l.

e) Inorganic nitrogen:

Nitrogen cycle involving elementary dissolved nitrogen; oxides: NO_3^-, NO_2^-; and reduced forms: NH_4^+, NH_3; plays a significant role in sustaining life in aquatic environment. NO_3^- is the end product of oxidation and the most stable form at pH 7.

Biogenic decomposition of organic matter in water proceeds by the reduction of available oxidants in the sequence $O_2 > NO_3^- > MnO_2 > Fe_2O_3 > SO_4^{2-} > CO_2$. In waters with high organic matter such as the Mahim Creek, the DO may be progressively depleted. Upon complete removal of DO, anaerobic micro-organisms become important and further decomposition of organic matter continues through the use of NO_3^- as an oxidising agent and then successively by MnO_2, Fe_2O_3 and SO_4^{2-}.

When bacteria and other organisms decompose organic matter, part of the N in organic matter is converted to organic N in microbial biomass and the remainder is released to the environment as NH_3. NH_3 generated as a product of organic matter decomposition is oxidised to NO_3^- in an aerobic environment or builds up in water under anaerobic conditions. Domestic sewage that is released in large volumes to coastal areas of Mumbai is also an important source of urea in seawater. Wide use of urea as fertiliser is another source of the compound to the sea via agricultural runoff and river discharges. In seawater urea is decomposed to yield NH_3 and CO_2 and therefore a potential source of NH_3. Unionized ammonia (NH_3) is in equilibrium with ammonium ion (NH_4^+) in water with much of the ammonia occurring in the ionized form (NH_4^+) at normal pH of seawater.

Except for one value (0.2 µmol/l) at station 3 in the bottom water, the concentration of NH_4^+-N in the Mahim Bay varied in the range 8.3 – 166.7 µmol/l and was at least by an order of magnitude higher than commonly occurring in the offshore areas of Mumbai. As in the case of PO_4^{3-}-P the concentration of NH_4^+-N was high in the surface layer on most occasions and the trend of concentration decreasing in the offshore direction was maintained.

The concentration of NO_3^--N on the contrary was invariably high in the bottom water unlike the levels of PO_4^{3-}-P and NH_4^+-N which were high in the surface layer. The concentration of NO_2^--N was invariably high (normal seawater value off Mumbai coast is <3 µmol/l) and varied in the range (0.3 – 23.4 µmol/l). Its distribution did not have a discernible pattern in the Bay though the values were often low during ebb tide.

f) Phytoplankton:

Phytoplankton forms the vast array of minute and microscopic plants passively drifting in natural waters and mostly confined to the illuminated zone. In an ecosystem these organisms constitute primary producers forming the first link in the food chain. Phytoplankton long have been used as indicators of water quality. Some species flourish in fresh water, while, some thrive in seawater. Further, some species proliferate in highly eutrophic waters while others are very sensitive to organic and/or chemical wastes. Several species develop noxious blooms, sometimes creating offensive tastes and odours or anoxic or toxic conditions resulting in animal death or human illness. Because of their short life cycles, plankton respond quickly to environmental changes. Hence their standing crop in terms of biomass, cell counts and species composition are more likely to indicate the quality of the watermass in which they are found.

Two samples collected on 19 August 2006 were studied for the population of phytoplankton and their generic distribution. The results are given in Table 3. The phytoplankton in these samples were represented by 18 - 22 genera with their population in the range 5.4 x 10^4 - 5.9 x 10^4 no/l. Their habitat was dominated by typical freshwater species namely *Agmenellum quadriduolicatum, Actinastum gracillium, Scenedesmus quadricauda, Oscillatoria chlorina, Fragilaria caucina* and *Pediastrum duplex* which constituted 45 and 50 % of the total population. Species of marine and estuarine origin namely *Rhizosolenia setigera, Navicula directa, Nitzschia selicatula* and *Nitzschia closterium* also occurred in these samples but their contribution was up to 20 % to their total population.

5 PROBABLE SOURCE OF LOW SALINITY WATER

The major freshwater source to the Mahim Bay during monsoon is the discharge of the Mithi River via the Mahim Creek through a narrow and shallow mouth in the north-eastern section of the Bay (Figure 1). The fate of the Mahim Creek discharge which can have salinity as low as 0.5 ppt during sporadic spells of high precipitation in the catchment is largely governed by the extent of its removal out of the Bay by tidal flushing and its mixing with the residual water of relative high salinity in the Bay. The high tidal range during spring would result in efficient flushing of water contained in the Bay to the sea and the rate of removal would decrease as the neap tide approaches. That means the Bay would contain higher content of water supplied through the Creek at neap tide as compared to the quantity retained at spring tide. Previous studies (Zingde and Desai, 1980) have shown that the high salinity (35 ppt) during April-May off Mahim Bay decreased considerably with the development of lateral salinity gradient during July-August under the influence of land runoff often leading to low salinities (8 -10 ppt) in the Bay. A marked decrease in salinity of water flowing into the Bay through the Mahim Creek during neap tide as compared to that of the spring ebb has also been well recognized. This was because of significant reduction of seawater incursion in the Creek during neap. As against 3 m spring rise at the Bay mouth, the level in the Creek rose barely by 1 m and was just 0.1 m at neap when the range was about 2 m at the Bay mouth. This was because of abrupt bed elevation at the mouth of the Mahim Creek and marked reduction in the cross-section. Hence, intrusion of brackish Bay water during flood tide in the Creek is considerably reduced (Zingde and Sabnis, 1994).

On 18 August 2006 when near fresh water was reported in the nearshore zone of the Mahim Bay, it was neap tide and the Vehar and Powai Lakes were overflowing into the Mithi River. On that day the high tide level at Bandra was at 0824 h and the water level fall with respect to the following low tide (1426 h) was by 1.19 m. The subsequent high tide (1903 h) raised the water level by mere 0.6 m. Hence the seawater intrusion in the Bay was considerably reduced and the Creek outflow during the ebb tide was probably of very low salinity. Recent deepening and broadening of the Mithi River and the Mahim Creek had increased their capacity to hold increased volume of water during flood tide thereby delivering high volume of low salinity water in the Bay during the subsequent ebb tide. Because of the density differences between the water of low salinity from the Creek and relatively high saline resident water in the Bay, the mixing between the two would be slow due to weak neap currents and under the prevailing circulation the water mass was transported in the south-westerly direction leading to low salinities recorded on 19 – 21 August 2006 at and around station 1. During the subsequent flood tide the low salinity water would have been pushed on the shore while it slowly mixed with seawater entering the Bay. Thus, the salinity of the surface water that was 2.9 ppt at the Creek mouth (station 4) increased to barely 4.4 ppt at station 1 during flood tide. This increase was from 0.4 to 4.2 during the ebb tide. Since station 1 was about 200 – 300 m away from the coast, low salinities (1.0 – 3.5 ppt) observed for samples collected on 19 August 2006 suggested the influence of some seepage of ground water from the adjacent landmass into the Bay. Transport of ground water in coastal areas during monsoon is a known phenomenon.

Due to insufficient mixing, the lighter low salinity water preferentially remained at the surface resulting in observed salinity difference between the surface and bottom water at all the Bay stations during the flood as well as the ebb tide (Figures 2 and 3). This difference was as high as 10 ppt at station 2.

Occurrence of stratification in the Mahim Bay even during spring tide has been reported (Zingde and Desai, 1980; Zingde and Sabnis, 1994). Apart from monsoon season, stratification sometimes occurred during dry season because the Mahim Creek received large volume of low salinity wastewaters such as sewage that drained in to the Bay during ebb tide. As the mixing of the two water masses was a delayed process there was distinct lateral salinity gradient with the salinity increasing from station 1 to station 3.

The other water quality parameters also supported the above conclusion that the source of the low salinity water in the Mahim Bay was the discharge from the Mahim Creek accumulating in the landward segment. The Mithi River and the Mahim Creek were known to be highly polluted water bodies receiving large volumes of sewage and industrial effluents and have been investigated in the past (Desai and Zingde, 1980; Sabnis, 1984; Zingde and Sabnis, 1989; Zingde and Sabnis, 1994). The summary of these studies is as follows:

The sewage releases in the Mahim Creek added 43 t of suspended solids, 45 t of BOD, 6 t of nitrogen and 1 t of phosphorus in the receiving water every day causing severe deterioration in the ecology of the Creek. The effluent load retained in the estuary constituted 16 % of the spring high tide and 40 % of the spring low tide volume of the Creek during dry season. The character of the suspended load changed with increase of inorganic component from 50 % in the Creek to 65 % in the Bay and further to 80 % in the offshore. The low pH of the Creek-water increased with increase in salinity and attained seawater value at or outside the Bay-mouth. The impact of high organic loading was marginal outside the Bay mouth but within the Bay the DO replenished with the inflow of seawater during flood tide was quickly consumed leaving very low to undetectable levels in the northern Bay unlike in the southern Bay where some DO generally occurred. Low to undetectable concentrations of NO_3^--N and NO_2^--N and presence of sulphide along with high concentrations of NH_4^+-N during low tide indicated sulphate reduction in summer; the conditions under which the local ecology was severely impaired. The Creek was generally devoid of DO, NO_3^--N and NO_2^--N in dry season except for brief periods of flood tide and the sulphide concentration exceeded 75 µmol/l. On the contrary, during monsoon the Creek sustained high concentrations of NO_3^--N and NO_2^--N due to aerobic oxidation of organic matter by DO associated with monsoonal runoff. The high flux of NH_4^+-N transferred via the creek outflow was only partially oxidized in the Bay leading to its high concentrations in the Bay water. The concentrations of PO_4^{3-}-P were high in the Bay and the Creek an often decreased with increase in salinity.

Under the World Bank assisted Bombay Sewerage Disposal Project, the domestic wastewater from certain zones was being collected and released through a marine outfall 3.4 km offshore. Recent studies (Dhage et al, 2006) conducted to assess the efficiency of marine outfall indicated that the Mahim beach had low DO with 60 – 75 % of values falling below SW II norms (>4 mg/l) of the Central Pollution control Board and there was no substantial improvement after the marine outfall became operational. Mahim beach water quality had deteriorated with the BOD values exceeding the SW II norms (<3 mg/l). The concentration of NH_3-N was high and exceeded the safe limit (1 mg/l) in 50 – 85 % of the samples as against 14 % samples prior to the commissioning of the outfall. High concentrations of PO_4^{3-}-P were also recorded at Mahim. The densities of fecal coliform were high (10^4 - 10^5 counts/100ml at the Mahim beach throughout the year. It was concluded that though the Municipal Council of Greater Mumbai had diverted some of the domestic wastewater through the marine outfall, the water quality of the Mahim beach had not improved. It was estimated that 1.96×10^5 m^3/d wastewater continued to enter nearshore region through non-point sources that probably was responsible for the absence of significant improvement in water quality of nearshore areas subsequent to the diversion of sewage through the marine outfall.

From the foregoing discussion it could be concluded that the outflow of the Mahim Creek in to the bay would have low salinity and low DO with high concentrations of NH_4^+-N, PO_4^{3-}-P and NO_2^--N. If the low salinity water that occurred in the Mahim Bay on 18 – 21 August 2006 had the source in the discharge from the Mahim Creek, then this water should have these signatures. It is clear from Tables 1 and 2 that the low salinity water had abnormally high levels of NH_4^+-N, PO_4^{3-}-P and NO_2^--N. This water preferentially remained at the surface resulting in observed low salinity and low DO coupled with high concentrations of NH_4^+-N, PO_4^{3-}-P and NO_2^--N. As the bottom water had high seawater component, the DO was high and the concentrations of NH_4^+-N, PO_4^{3-}-P and NO_2^--N were relatively low. The high concentration of DO in samples obtained on 19 August 2006 was probably because of diffusion of atmospheric oxygen in water in the surf zone from where the samples were collected. As the seawater component increased in the seaward direction, the DO also increased from station 1 to station 3. Likewise, the DO decreased during low tide as the content of Creek water in the Bay increased. This was also supported by decreasing concentration of PO_4^{3-}-P and NH_4^+-N in the seaward direction.

The distribution of phytoplankton species in the Bay also supported the accumulation of discharge of the Mahim Creek in the Bay. The two samples collected from the shore of the Bay on 19 August 2006 were dominated by fresh water species of phytoplankton to the extent of 45 – 50 % (Table 3). Occurrence of fresh water species such as *Agmenellum quadriduolicatum, Actinastum gracillium, Scenedesmus quadricauda, Oscillatoria chlorina, Fragilaria caucina* and *Pediastrum duplex* is uncommon in the coastal waters of Mumbai. These species were probably transported to the Bay through the overflow of the Vehar and Powai Lakes. *Agmenellum quadriduolicatum, Actinastum gracillium* and *Fragilaria caucina* generally thrive in lakes and reservoirs and were probably the natives of the Vehar and Powai Lakes.

6 CONCLUSIONS

The investigations conducted in the Mahim Bay on 19 -21 August 2006 resulted in the following conclusions:

a) The source of low salinity water in the landward segment of the Mahim Bay was the discharge of the Mahim Creek that accumulated due to density differences between the Bay and Creek waters and sluggish tidal movements at or around neap tide. This was supported by physico-chemical characteristics of the Bay water as well as by dominance of fresh water phytoplankton in the inner Bay.

b) The Bay water is severely degraded with low DO and high concentrations of NH_4^+-N, PO_4^{3-}-P and NO_2^--N probably due to contamination by sewage.

7 REFERENCES

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Table 1: **Physico-chemical characteristics of Mahim Bay water on 19 August 2006**

Sample	**Time (h)**	**pH**	**Salinity (ppt)**	**DO (ml/l)**	**NH_4^+ -N (µmol/l)**	**PO_4^{3-} -P (µmol/l)**	**NO_2^- -N (µmol/l)**	**NO_3^- -N (µmol/l)**
1	1210	7.8	3.3	5.4	78.6	15.1	17.6	8.4
2	1230	7.8	3.4	5.0	73.6	14.9	16.2	8.5
3	1250	8.0	1.6	NS	8.3	20.9	17.6	13.1
4	1300	7.7	3.1	4.1	92.6	15.8	14.8	12.3
5	1400	7.7	3.4	5.0	78.9	14.5	16.0	9.6
6	1400	7.7	3.4	5.0	77.3	14.2	14.0	15.1
7	1420	7.8	3.0	4.8	72.8	14.8	21.7	2.8
8	1610	7.8	3.4	5.0	82.7	13.3	14.7	7.6
9	1615	7.8	3.5	4.8	85.6	14.7	14.8	4.3
10	1630	7.8	3.2	3.6	84.8	14.4	21.2	7.9
11	MPS	7.7	1.0	NS	57.5	14.1	16.2	12.9

NS- Not sampled

MPS- Sample made available by Mahim Police Station collected early morning on 19 August 2006

Table 2: **Physico-chemical characteristics of Mahim Bay water on 21 August 2006**

Station	Time	Level	pH	Salinity (ppt)	DO (ml/l)	NH_4^+ -N (µmol/l)	PO_4^{3-} -P (µmol/l)	NO_2^- -N (µmol/l)	NO_3^- -N (µmol/l)
1	1145	S	7.7	4.4	1.3	125.5	32.7	3.6	5.8
		B	7.7	12.6	2.7	77.4	13.3	5.9	20.7
	1415	S	7.7	5.3	2.7	74.2	22.0	4.7	8.0
	1715	S	7.7	4.2	1.1	134.6	25.8	2.3	4.8
2	1200	S	7.7	5.7	2.0	135.7	22.2	4.2	6.2
		B	7.9	14.9	4.0	34.0	9.9	2.8	16.7
	1415	S	7.6	4.7	1.1	131.9	24.6	2.2	4.2
		B	7.8	11.8	2.7	49.0	14.0	6.8	13.7
	1655	S	7.6	3.1	0.2	138.4	34.2	1.0	0.9
		B	7.5	4.0	0.9	128.7	37.3	0.8	21.9
3	1225	S	8.0	11.1	4.5	54.9	11.9	5.6	15.6
		B	8.0	19.1	3.8	12.6	12.9	5.2	18.9
	1430	S	7.9	9.1	4.0	166.7	3.6	23.4	1.1
		B	7.9	19.9	1.3	0.2	14.3	0.3	21.4
	1630	S	7.6	8.0	2.5	107.9	7.9	3.7	10.8
		B	7.8	18.2	3.8	23.3	19.2	0.7	27.4
4	1115	S	7.6	2.9	0.4	118.0	8.3	0.6	0.9
		B	7.6	6.2	0.7	112.7	21.6	3.4	7.0
	1730	S	7.6	0.4	ND	83.8	18.4	0.6	1.4
5	1300	S	7.8	8.0	4.0	93.9	46.8	6.2	6.2
		B	7.8	15.5	3.8	18.5	15.5	5.8	24.5
	1645	S	7.5	4.6	0.4	95.6	7.4	4.2	1.0
		B	7.6	11.8	2.9	60.8	29.9	8.0	21.1
6	1330	S	7.6	12.0	3.4	46.9	11.5	8.2	15.1
	1600	S	7.9	10.0	4.9	61.8	13.4	6.4	13.4

S- surface; B-Bottom

Table 3: **Percentage composition of phytoplankton in Mahim Bay on 19 August 2006**

Genera	Sample 1	Sample 2
Actinastrum	8.1	8.2
Agmenellum	8.1	23.5
Anabaena	1.3	
Ankistrodesmus	1.3	4.4
Calothrix	-	2.9
Closterium	1.3	1.5
Cymbella	-	1.5
Fragilaria	12.2	5.9
Guinardia	2.7	-
Hemiaulus	1.3	-
Leptocylindrus	1.3	5.9
Melosira	-	5.9
Navicula	8.1	4.4
Nitzschia	10.8	5.9
Oscillatoria	12.2	13.2
Pediastrum	1.3	4.4
Phormidium	6.8	-
Rhizosolenia	1.3	2.9
Richelia	1.4	-
Scenedesmus	2.7	2.9
Skeletonema	5.4	-
Spirulina	2.7	2.9
Synedra	6.8	1.4
Trichodesmium	1.4	-
Ulothrix	1.4	-
Total genera (no)	**22**	**18**
Total population (nox10^3/l)	**59.2**	**54.4**