Telescopium. telescopium AS BIOINDICATOR OF POLLUTION IN THANE CREEK

Dr.J.G.Koliyar[1] & Ms. Akshata Devadiga[2]
Assistant Professor[1] & Student[2]
Department of Environmental Sciences
SIES (Nerul) College of ASC, Nerul, NaviMumbai, Maharashtra, India

ABSTRACT

Thane Creek is an important estuary of Mumbai. Thane Creek is an inlet along the shoreline of the Arabian Sea that isolates the city of Mumbai from the Indian mainland. Estuaries are among the world's most productive ecosystem. The Bhandup pumping station area which is a part of the Thane Creek was selected for the project. This paper discusses about the pollution in Thane Creek caused due to the Waste water treatment plant's discharge. The study was carried out using T.telescopium, which is a molluscan species, as a bioindicator. Three sites were identified and samples were collected every 45 days starting from the month of July and samples of water, sediment were collected and analyzed and its correlation with the change in the number of a molluscan species (*Telescopium. telescopium*) was studied. A total of four samples were collected from all the 3 sites for the project. The counting of T.telescopium was carried out by using the line transect method during each sampling. The physico-chemical parameters considered for study include pH, Temperature, DO, COD, BOD, Salinity, Hardness, Nitrates, Phosphates, Conductivity, Alkalinity, TDS for water sample and pH, Temperature, Organic matter, Phosphorous, Nitrogen, Moisture content, Chlorides, Conductivity for soil sample. After the analysis was conducted, all the data was compiled in a tabular form and the statistical analysis was carried out successfully using SPSS software. The results were then interpreted and thus, from the result it was concluded that water parameters like DO, BOD and Soil parameters like Nitrogen and Chlorides directly impacted the number of the T. telescopium species with the least number of the species in the 3rd site indicating that the more the pollution at a site, the less is the number of the molluscan species. The changes in these parameters due to pollution can lead to devastating effects on the natural ecosystems.

Index Terms: Creek, *Telescopium. Telescopium*, bioindicator, physico-chemical parameters, molluscan

Introduction:

India hosts rich coastal and marine biodiversity in various wetland habitats such as creeks, mangroves, mudflats and salt marshes. Mangroves play an important part in providing habitat for a variety of planktonic and benthic organisms [1].Estuaries provide vital nesting and feeding habitats for many aquatic as well as terrestrial plants and animals. India has an extensive coastline of about 8,129 km and of this nearly 6,000 km is in the form of estuaries, creeks, brackish water lagoons and lakes [2]. A study, carried out in 8 mangrove areas of Mumbai, west coast of India, from August 2015 to May 2016, revealed a distribution of 61 molluscan species, represented by 46 gastropods, 14 bivalves and 1 polyplacophora [13]. The number of species reported from the study is the second highest for the mangrove ecosystems of India, after Andaman and Nicobar Islands mangroves. Among gastropods, species of the following genera: Pirenella, Cassidula, Melampus, Littoraria, Telescopium, Neripteron, Onchidium, and Elysia bengalensis were observed to occur exclusively in the mangrove environment [13]. ***Telescopium. telescopium***, or "Horn snail," is a species of marine arthropod mollusk in the family Potamididae. The animal is velvety black with a highly extendible proboscis.The capability of surviving in the intertidal zone may make them an attractive subject for exploring the impact of environmental pollutants [14]. In the following project, the monitoring of the pollution in Thane Creek has been carried out on the basis of difference in the number of organism of the molluscan species *Telescopium. telescopium*. Three locations in the creek were randomly selected and samples of water, sediment were collected and analyzed and its correlation with the change in the number of a molluscan species (*Telescopium. telescopium*) was studied. The area of study in this project is Bhandup Pumping station area which is connected to the Thane Creek. Thane Creek lies in the southern part of the Deccan belt of India. The area is part of and synonymous with the recently established 'Thane Creek Flamingo Sanctuary' is spread out over 1,690 hectares. It has been recognized as an Important Bird Area (IBA) by the Bombay Natural History Society, an initiative by Birdlife International to identify global avian diversity hotspots. The area has a Sewage Treatment Plant which releases the treated effluents into the creek. The diversity of the flora and fauna of this area has been degrading lately due to the Sewage Treatment Plant. The reason could be the great amount of Industrial effluents that is sent to the STP which has lead to an increased load on the STP and hence the target standards of treated effluents are not met before they are released into the water body.

Three sites were selected and samples were collected. **Site 1 -** Longitude 19°08'20"N Latitude 72°57'48"E. It is a huge water body within the Bhandup Pumping Station. The stretch shows some good sign as there is still a good cover of mangrove around it. A variety of birds are found in and around this water body. The water is comparatively clean here based on its color and odour as compared to Site 2 and 3.**Site 2 –** Longitude 19°08'20"N Latitude 72°57'49"E. This stretch is a very small and enclosed water body. The water has a particular stagnant odour. Some plastic bags, thermocol wastes are dumped nearby. Also the water has soapy lather sometimes. **Site 3 –** Longitude 19°08'21"N Latitude 72°57'28"E. This place is downstream to the effluent discharge pump of the Sewage treatment plant. All the treated effluents are discharged here. The place has a foul odour. The water is visibly polluted. Also it's the place from where boats are available which take birdwatchers for Flamingo sightings. This water body meets the main Thane Creek as it flows forward.There has been gradual decrease in the amount of D.O. in Thane Creek since 1981 [8] The dissolved oxygen in an estuary is affected by various factors such as salinity, temperature, currents, pollution load as suspended matter, phytoplankton, etc [9]

Materials and Methods:

The study area was inspected once before the actual sampling in order to decide the sampling sites to be selected and to understand the route to the sites. Samples of water were collected from 3 selected sites within Bhandup Pumping Station once in every 45 days from July to December by taking grab samples using random sampling method. The collected water samples from various sites were analysed for physical, chemical parameters.

Counting of the species

- The numbers of T.telescopium mollusc species were counted in the selected 3 sites by using Line Transect Method.
- Lines were placed randomly across the study region, and each line was transversed, recording the number of *T. telescopium* which touched the line.
- Counting was done once in 45 days from July to December.
- The lines used were 5 meters in length and counting was carried out within 5 meters from the water body.

Results and Discussions

The Water and Soil samples were analyzed for the various physicochemical parameters like pH, Temperature, DO, COD, BOD, Salinity, Hardness, Nitrates, Phosphates, Conductivity, Alkalinity, TDS for water sample and pH, Temperature, Organic matter, Phosphorous, Nitrogen, Moisture content, Chlorides, Conductivity for soil sample.

The pH of the overall samplings of all the sampling sites ranged from 8.8 to 6.7. The pH value of Site 1 during the third sampling was found to be highest i.e. 8.8. The remaining samples fall within the standards given by CPCB which is 6.5-8.5. The pH is affected by chemical pollutants. These chemicals can come from agricultural runoff, wastewater discharge or industrial runoff and Wastewater discharge that contains detergents and soap-based products can cause a water source to become too basic. The natural causes for pH change can be mainly due to presence of different salts. The presence of carbonates and bicarbonates can lead to increase in pH. When pH falls below 6.5 or rises above 8.5, many of the important nutrients become unavailable to plants and the overall productivity is lowered. The SPSS test shows that there is no significant correlation between *T.telescopium* and the water pH at 0.05 L.O.S which indicates that the species population is not directly affected by changes in pH. However a positive correlation may exist between the parameters.

The temperature in Site 1 ranged from 26°C to 28°C during all the four sampling. The temperature of Site 2 ranged from 23°C to 26°C with lowest reading during the fourth sampling indicating either the reduced amount of nutrients or inflow of water due to high tides. The Site 3 temperature varied from 24°C to 27°C. Overall there were no high variations in the waters in all the four sites. The SPSS test shows no significant correlation between the number of *T.telescopium* and the temperature of water at 0.05 L.O.S indicating that the species is tolerant to slight temperature variations. However a positive correlation may exist between them.

The Dissolved Oxygen levels overall in all 3 sites ranged from 0-11.7 mg/l. The DO levels are found to be more than 4 mg/l, which is the minimum DO level that is necessary for a healthy water body as per CPCB and IARI Standards. The DO level below this range indicates hypoxic conditions. The DO level in all four samples from site 1 was found as per standards. Site 2 shows low DO except during the 3rd sampling. Site 3 shows below detectable DO values during the first 3 sampling. During 4th sampling readings above 2.5 has been recorded. Oxygen enters water through diffusion from air, wind and wave actions and plant photosynthesis. The dissolved oxygen in an estuary is affected by various factors such as salinity, currents, pollution load as suspended matter, phytoplankton, etc. The reasons for the low DO in Site 2 may be pollution caused by waste dumped nearby the water body and presence of high organic discharges. The Site 3 is downstream and near to the effluent discharge pump of the STP and that may be the reason for the reduced DO in the immediate site which may adversely affect the biological organisms in and around the water. The SPSS test shows that the correlation of *T.telescopium* was found to be significant for Dissolved Oxygen levels of the water sample (0.622 at 0.05% L.O.S). This indicates that the species number shows direct relationship with the DO levels in the water sample.

The COD value of the 1st sampling of site 1 was as per the standards by MPCB. The overall COD from all the sites ranged from 250 mg/l to an extremely high level of 6000mg/l which is very high when compared with the standards given by MPCB. The COD levels in all the 3 sites were lower during the 1st sampling than the 4th which could be due to dilution of water by the rain. COD is an indicator of organic pollution in surface water. The increased COD in the 1st site may be due to high amount of chemicals in the storm water which was higher than the 2nd sites value during the 4th sampling. The reason for high COD in the 2nd site may be due to the bottles and cans that are seen everywhere there which may contain some food residues. Also Site 2 is an enclosed and small water body which may also be a reason for the concentration of the organic pollutants in that water body. The average COD values of the 3rd site were highest when compared to the 1st and 2nd site. The reason may be the sewage discharge in that area. The SPSS test shows that there is no significant correlation between *T.telescopium* and the COD levels of water sample which indicates that the species population is not directly affected by changes in COD. However a positive correlation may exist between the parameters.

The BOD was found to be high in the site 3 as compared to site 1 and site 2 during the overall duration of sampling. The BOD values for 3rd sample of Site 1 and all the samples for site 1 and site 2 exceeded largely the standards given by MPCB which is 30mg/l for inland surface water. This indicated high organic pollution in the waters which can be due faecal contamination or increase in particulate and dissolved organic carbon from non-human and animal sources. This can lead to the deterioration of the overall quality of the creek, reduced DO and fouling due to aerobic and anaerobic decomposition. The SPSS test shows that

there is a significant correlation between the numbers of *T.telescopium* and the BOD levels of water (0.016 at 0.05% L.O.S) which indicates that the species show a direct relationship with the levels of BOD.

Chloride was found to be high in all the samples during all the sampling. All the values exceed the range given by CPCB i.e. 600mg/l. The value in all the 3 sites during the 2nd sampling was lower as compared to the 4th sampling of all the 3 sites. Chloride concentration in water indicates the presence of organic waste in water, primarily of animal origin. All natural waters contain chloride ions ad sulphate ions which vary according to the mineral content of earth in any given area. High chloride content in water sample may be due to the pollution from chloride rich effluent of sewage and municipal waste. The SPSS test shows no significant relationship between the T.telescopium species and the chloride levels of water indicating that there is no direct effect of chlorides on the species numbers. However a positive correlation may exist between them.

The alkalinity of water is a measure of its capacity to neutralize acids. Alkalinity is due to the presence of bicarbonates, carbonates and hydroxides. The weathering of rocks is the potential source of alkalinity. In large quantities alkalinity imparts bitter taste to water. The alkalinity of all the samples during all the sampling are within the CPCB norms. The SPSS test shows no significant correlation between the number of *T.telescopium* and the Alkalinity of water indicating that the species is tolerant to slight variations in alkalinity. However a positive correlation may exist between them.

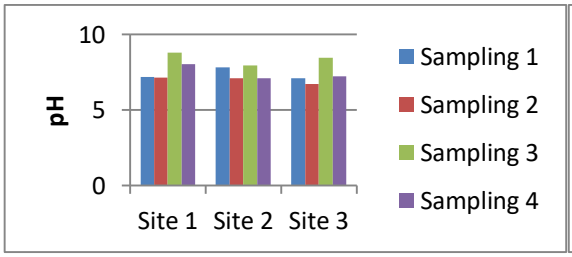
The hardness values ranged from 76mg/l to as high as 3800 mg/l. Since there are no standards set by MPCB for discharge hence there is no control over the water which is drained. The 3rd sampling of Site 3 shows highest hardness value. Higher hardness may be because the site is close to the treated effluent discharge pump of the STP Plant. All the 3 sites showed low hardness which may be because of the inflow of water due to rains. Also all the 3 sites showed high hardness values during the 3rd sampling. This shows the presence of high concentration of multivalent metallic cations. The SPSS test shows that there is no significant correlation between *T.telescopium* and the hardness of water which indicates that the species population is not directly affected by some changes in hardness. However a positive correlation may exist between the parameters.

The Nitrate levels were comparatively low in all the samples with the Nitrate levels being below detectable range in the 2nd and 3rd sample of all the 3 sites. The highest value was observed in the 4th sample of Site 3 which was 0.5mg/l. Nitrates in surface water at levels lower than the drinking water standard i.e. 20 mg/l may cause eutrophication. The standard minimum value for Nitrate is 50 mg/l. The SPSS test shows that there is no significant correlation between *T.telescopium* and the nitrate levels in water which indicates that the species population is not directly affected by changes in nitrate levels. However a positive correlation may exist between them.

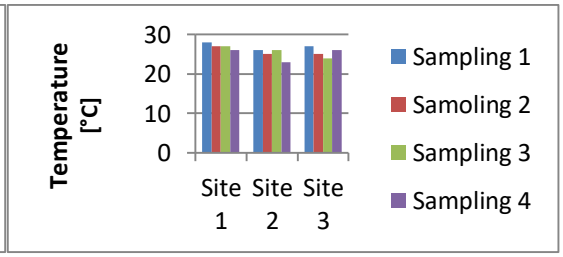
The Phosphate values ranged from 0.9mg/l to 7.9mg/l. The values of samples of all sites from the 1st sampling are higher than the standard given by MOEF which is 5mg/l for discharge of phosphorous in inland surface water body. Water contains phosphates derived from natural contact with minerals or through pollution from application of fertilizer, sewage and industrial waste. The SPSS test shows that there is no significant correlation between the number of T.telescopium and the phosphate levels in water which indicates that some variations in the phosphate levels of water do not impact the number of species directly. However a positive correlation may exist between the parameters.

All the 3 sampling sites, during their first three sampling show higher values for Electrical conductivity than the standard given by CPCB which is 1 S/m or 1000 milli mhos/cm. The values in site 1, 2 and 3 ranged from 0.39- 3.1 S/m, 0.39- 3.2 S/m and 0.40- 4.3 S/m respectively. Increase in the conductivity are often seen due to high levels of inorganic dissolved solids such as chloride, nitrates, sulphates, phosphate ,sodium, magnesium, calcium and aluminum. The conductivity of the 4th sampling of all sites showed Conductivity within the standard. The SPSS test shows no significant correlation between the number of *T.telescopium* and the electric conductivity of water indicating that the species is tolerant to slight variations in electric conductivity.

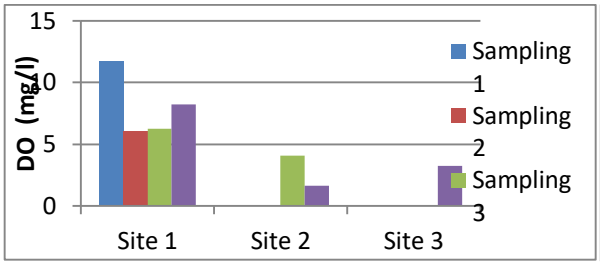
The TDS values in the overall samples ranged from as low as 600 mg/l to as high as 34000mg/l. The values were found to be extremely high in the 4th sample of all the sites. The highest value was recorded in the 3rd sample of Site 3. Such high TDS may be due to the presence of carbonates, bicarbonates, chlorides, phosphates, calcium, magnesium, etc. in abundance. The high content of dissolved solids increases the density, turbidity, hardness, salinity, etc. of the water. The high content of TDS also reduces the solubility of gases like oxygen and reduces the utility of water. The SPSS test shows that there is no significant correlation between *T.telescopium* and the water TDS which indicates that the species population is not directly affected by changes in TDS. However a positive correlation may exist between the parameters.

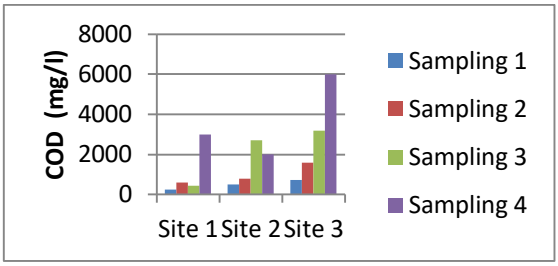


Graph 1 shows pH variations in three sites



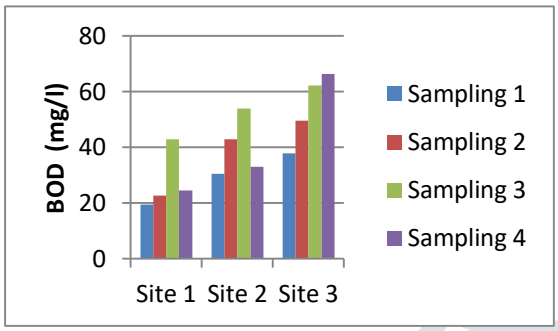
Graph 2 shows Temperature variations in three sites

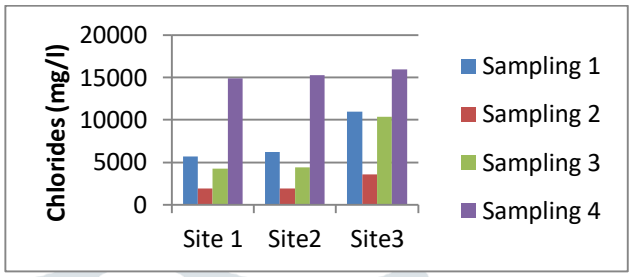




Graph 3 shows Dissolved Oxygen variations in three sites

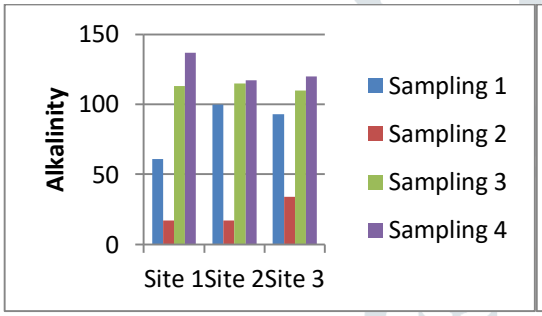
Graph 4 shows COD variations in three sites

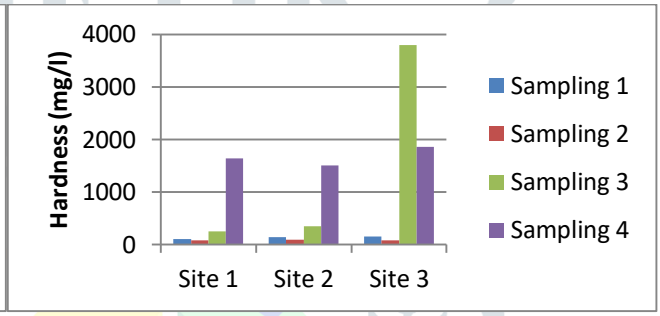




Graph 5 shows BOD variations in three sites

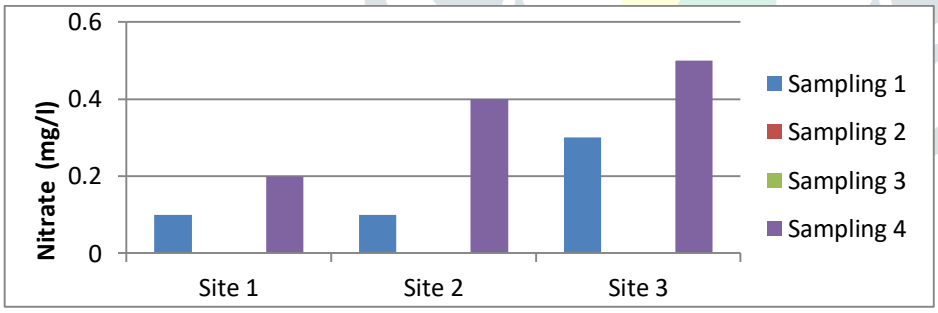
Graph 6 shows Chloride variations in three sites



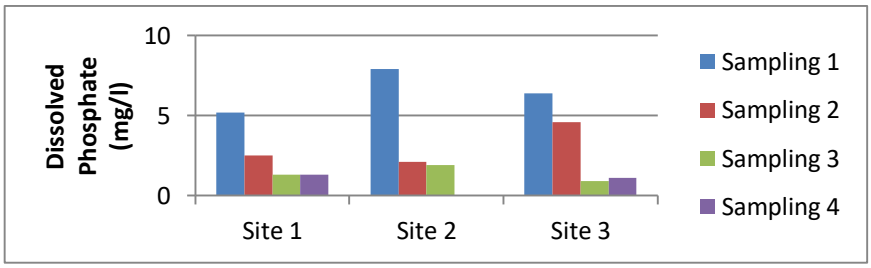


Graph 7 shows Alkalinity variations in three sites

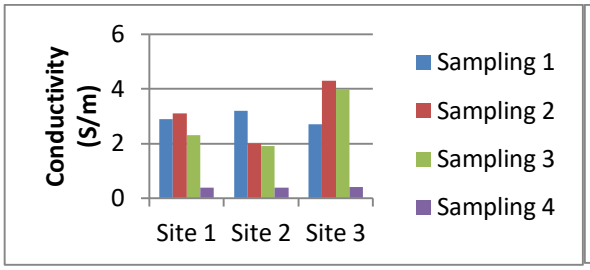
Graph 8 shows Total Hardness variations in three sites



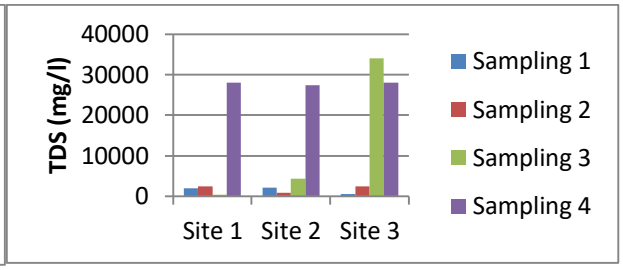
Graph 9 shows Nitrate variations in three sites



Graph 9 shows Phosphate variations in three sites



Graph 10 shows Conductivity variations in three sites



Graph 9 shows TDS variations in three sites

Conclusion

Use of bio indicators like mollusks has been one of the most effective measures to identify and measure the amount of pollution in a particular environment. This study revealed that the water of the 3rd site was most affected by effluents discharged by the STP Plant. Water parameters like DO, BOD directly impacted the number of the *T.telescopium* species with the least number of the species in the 3rd site indicating that more the pollution at a site, the less is the number of the molluscan species. The changes in these parameters due to pollution can lead to devastating effects on the natural ecosystems. The DO level below its normal range indicates hypoxic conditions which can lead to death of organisms and also change the physical and chemical properties of the aquatic ecosystem. High amounts of BOD can lead to the deterioration of the overall quality of the creek, reduced DO and fouling due to aerobic and anaerobic decomposition.

References

[1] Nagelkerken, I., S.J.M. Blaber, S. Bouillon, P. Green, M. Haywood, L.G. Kirton, J.O. Meynecke, J. Pawlik, H.M. Penrose, A. Sasekumar & P.J. Somer-field (2008). The habitat function of mangroves for terrestrial and marine fauna: A review. *Aquatic Botany* 89: 155–185.

[2] Dhinamala K, Pushpalatha M, Samuel T, Raveen R. Spatial and temporal variations in the water quality parameters of Pulicat Lake, Tamil Nadu, India. International Journal of Fisheries and Aquatic Studies 2015; 3(2): 255-259

[3]Van Dolah, R.F., Chestnut, D.E., Johns, J.D, Jutte, P.C, Riekere, G., Levisen, M., and McDermott, W., The importance of considering special attributes in evaluating esturine habitat condition: The South Carolina experience. Environ. Monit. Assess., 81 (2003) 85-95.

[4]Mallin, M.A. and Lewitus, A.J., The importance of tidal creek ecosystem. J. Exp. Mar. Biol. Ecol., 298(2) (2004) 145-14

[5] Bela Zutshi and S. G. Raghu Prasad. Impact of pollution on fresh- and marine water resources- A review. Enviromedia. Poll Res 27(3) : 461-466 (2008).

[6] Sushmita Negi. Study of physicochemical parameters and heavy metal accumulation in soil sediment and leaves of Avicennia marina (Forsk.) Vierh. International Journal of Applied Environmental Sciences ISSN 0973-6077 Volume 12, Number 6 (2017), pp. 1241-1248.

[7] Dwivedi, S.N. and Padmakumar, K.G. 2012. Ecology of a mangrove swamp near Juhu Beach, Bombay with reference to sewage pollution, Physiology and management of mangroves, Springer: 163-170.

[8] Vinay S. Nikam, Arun Kumar, Kamal Lalla and Kapil Gupta; Conservation Wetlands and Mangroves in Thane Creek and Ulhas River Estuary, India;The 12th World Lake Conference 1635-1642, 2008

[9] Goldin Quadros, Vidya Mishra, Vidya Ullal, K.S. Gokhale and R.P. Athalye; Status of Water Quality of Thane Creek (India); Ecol. Env. And Cons. 7(3) : 2001; pp. (235-240)