

ABSTRACT

Some Microbiological Aspects of Waste Water Treatment

Jeanelle Marguerite Roberts

The aim of this study was to investigate the use of phytoplankton as indicators of water quality in a sewage treatment pond system. The species composition and abundance of phytoplankton within the Greater Portmore Waste Stabilization Ponds (GPWSP) was assessed over a two-year study period (July 1993 - June 1995) in relation to nutrient status. Coliform bacteria density was estimated in the ponds and constructed wetlands to investigate the role played by each of these systems in effecting coliform bacteria die-off. Simpson's diversity index was calculated for each pond. Similarly, a Jaccard Community Coefficient (JCC) Matrix and a Percentage Similarity Coefficient (PSc) Matrix were calculated for the ponds so as to test the degree of association between the ponds in the Greater Portmore Waste Stabilization Pond System. In addition to this, experiments were conducted to observe the effect of various concentrations of different nutrients on the colonies of the commonly occurring green alga, *Scenedesmus quadricauda*.

Monthly samples were taken from the ponds between July 1993 and June 1995 and from the constructed wetlands between August 1994 and June 1995.

Variations in phytoplankton communities within the individual ponds and overall pond system were observed over time. Chlorophytes and euglenophytes were observed to decrease from Pond 1 effluent to Pond 4 effluent. Cyanophytes, cryptophytes and bacillariophytes displayed the opposite trend. In year 2 (July 1994 to June 1995),

cyanophytes displayed a sharp decrease from Pond 2 effluent to Pond 4 effluent. this change appeared to be mirrored by a sharp increase in bacillariophytes from Pond 2 effluent to Pond 4 effluent. Cryptophytes displayed a greater increase from Pond 2 effluent to Pond 4 effluent in year 2 than in year 1. No distinct pattern was exhibited by the dinophytes. The change in phytoplankton composition and abundance indicated the significant progress in water treatment. The presence and absence of the various phytoplankton within the ponds also indicated the progress in water treatment. Bacillariophytes were observed to be the best indicators of the efficiency of the treatment of the waste water in the ponds.

Diversity was found to increase slightly from Pond 1 effluent to Pond 3 effluent with a subsequent decrease in Pond 4 effluent. Diversities were all high, being in the range of 0.86 - 0.88. From the Jaccard Community Coefficient Matrix, Pond 1 effluent and Pond 4 effluent were calculated to be most dissimilar. On the other hand, in the Percentage Similarity Coefficient Matrix, Pond 1 effluent and Pond 3 effluent were calculated to have the greatest difference between them. Therefore, there is a significant change in community from pond to pond thus indicating the presence of different conditions within each pond.

Few simple regressions were found between phytoplankton-related variables and physical and chemical variables. Physical and chemical variables were found to give a stronger relationship when acting together.

In the series of *Scenedesmus quadricauda* experiments, pH was found to be the most regulatory factor of those tested; lethal pH being 8.5. The order of decreasing effect of regulatory factors was pH > ammonia-nitrogen > nitrate-nitrogen > phosphate-phosphorus. Two-celled colonies were confirmed to give rise to four-celled colonies.

The progressive die-off of coliform bacteria mirrored the increase in pH from the influent to the effluent in the ponds i.e. Pond 4 effluent; this increase in pH being a result of algal photosynthetic activity. However, no statistical relationship was found. Coliform bacteria reduction in the ponds was calculated to be > 98% indicating that the ponds were highly efficient. In the constructed wetlands, the efficiency of the beds in coliform bacteria removal was Rice > *Typha domingensis* > Young *Typha domingensis*. The beds were found to contribute further to coliform die-off and completely remove phytoplankton from the effluent of the ponds. This indicated that the constructed wetlands were an essential component of the Greater Portmore Integrated Waste Water Treatment system.