CHAPTER 5

DISCUSSION

5.0 DISCUSSION

5.1 Field physical and chemical parameters

Generally, mean physical and chemical parameters of all the five water sampling stations were not significantly different between the stations except secchi depth and silica. It is not surprising because the study was carried out at a relatively restricted study area and the distance between two different stations were approximately 100 m to 150 m apart (Ryding & Rast, 1989).

The results of two-way ANOVA indicated that the variance in the data were due to spatial and/or temporal factor. In this study, temporal factor plays rather a more important role than spatial factor due to closer distance between the sampling locations. In addition, the sampling stations are located at the same catchment area where the physical and chemical properties of water quality in the lake were influenced by the geological formation in the area.

Overall, the temperature and pH fluctuated regularly due probably to changes in weather conditions and monsoon seasons. All the pH levels were slightly acidic except some stations in December 2000 (Figure 10). The decreasing trends of pH levels at the station might be influenced by the high rainfall as observed on-site in December 2002 compared to other months during the visits. The rainfall pattern is governed by annual monsoonal cycles with the highest rainfall recorded in November and December compared to lowest rainfall in June and July (Putrajaya Holdings, 1996).

The mean conductivity level decreasing from station I to station V as shown in Figure 13 reflects the decreasing level of dissolved ions in the water from station I to station V. This could probably be affected by land clearing activities at the upper catchment which caused loss of ions from the disturbed land. Station I is the first point of water discharge after filtering through the vegetation in the wetlands. Therefore, it is expected to have higher mineral content compared to other stations downstream. Moreover, it may also caused by the dilution effects of runoff from the developed area downstream (Parcels C and D of Precinct 1), under construction (Precinct 16) and undeveloped area (Precinct 17) where runoff discharging through drainage system at Precinct 16.

The dissolved oxygen levels ranging from 5.0 mg L^{-1} to 6.8 mg L^{-1} were affected by temporal factor. The low oxygen level especially at station II may due to turbid conditions where less photosynthetic plant and phytoplankton were found which contribute to oxygen contents in the water. Besides that, decomposition of organic matter also further reduce the dissolved oxygen (Lund & Lund, 1995).

The secchi depth at stations I, II and V was influenced by the location of each station. In normal conditions, station II had the lowest transparency of water due to high turbidity resulting from sediments churned up in the lake by the waterfalls from the weir structures. The exceptions were on 6^{th} December 2000 and 6^{th} January 2001 where rain occurred the day before (Figure 16). During rainy days, suspended sediments from exposed areas at the upper catchment were delivered into the wetlands which act as an filtering mechanism to reduce the amount of sediments being discharged downstream to the lake. However, the wetlands system is capable of removing to certain degree of suspended solids in the water through sedimentation which enhanced by very low flow velocities, wetland plants and plant debris in the wetlands (Tchobanoglous & Burton, 1991). Therefore, lower transparency readings at station I were recorded compared to station II on the two occasions. During dry weather, the water at station I was relatively clear because the wetland plants filtered the suspended particulates in the water.

The variance in dissolved orthophosphate and ammoniacal nitrogen were mainly due to temporal factor. On 24th February 2001, the dissolved orthophosphate and ammoniacal nitrogen levels at station II increased significantly more than two-fold compared to water samples collected during normal conditions. The water at the surrounding area of station II was very turbid. This was due to the construction of a pumping station near the water sampling station where muddy water discharged out from the construction area to the surroundings which also disturbed the sediments deposited in the lake. This helps phosphorus deposited with sediments be recycled and released into the lake (Reynolds & Davies, 2001). The concentration of nutrients in the water under normal conditions is very low as recorded in this study.

In general, Figure 23 shows the concentration of silica decreased from station I to station V because the majority input of silica was from the land clearing and earthworks activities at the upper catchment area. On 24th February 2001, the muddy water discharge from construction activities had caused the concentration of silica at station II to increase approximately two-fold.

5.2 Biotic variables

Table 3 shows the phytoplankton species found in the Bisa Lake from December 2000 to March 2001. 15 species or 55.5% of phytoplankton recorded in this study was from chlorophyceae compared to 46% (Tang, 2001) and 52.5 to 67% (Anton *et al.*, 1991) at Tasek Bera and Pansoon Dam, Hulu Langat, Selangor. This indicated that Chlorophyceae was the most dominant in the lake and dam even though the number of phytoplankton species that found in this area was very low compared to the 326 species reported by Tang (2001) in Tasek Bera. The difference species abundance might due to the age of the site where Tasek Bera has been established for more than 4,500 years and the Bisa Lake was inundated with water only in January 1999.

In addition, nine species was recorded under Desmidiaceae the highest number of species compared to others. The favourable conditions of "soft" water (poor in salts calcium and magnesium) and pHs (5.0 to 7.0) encourage the presence of desmids in the lake (Lund & Lund, 1995).

Station I recorded only 16 species compared to other stations which had 22 to 23 species. Less species of phytoplankton at station I was likely to be due to lack of nutrients in the water after flowing through the wetlands which consist of many types of plants to absorb nutrients in the water (Putrajaya Corporation, 2000). On the other hand, it may be also due to effects of other environmental variables which were not examined in this study.

Cell density and chlorophyll-a of phytoplankton at station I were significantly lower than other stations because of different nutrient contents. Two-way ANOVA indicates that both of the variables were affected by spatial and temporal factors. Wetland plants at the upper part of station I were able to filter most of the pollutants in the water before discharging to the lake. However, at downstream of station I, water was contaminated with various sources of pollutants from the drainage system which discharge runoff water from the sub-catchment area into the lake system. The sources of nutrients were mainly from the construction works at Precinct 16 near to station II. During construction, portable toilets were built on-site to cater for workers but sometimes sewage from the portable toilets was discharged to the lake directly through constructed drainage system due to lack of proper maintenance. This became worse when the toilets were insufficient for the foreign labour workers and they had to release it into the nearby waterways. The untreated sewage discharge is enriched in nitrogen and phosphorus contents (Tchobanoglous & Burton, 1991). The presence of phytoplankton belonging to the families Desmidiaceae (*Staurastrum* diptilum, *S. pentacerum*, *Cosmarium medioscobiculatum*) at station II to station V (Table 3) may due to the high concentration of nutrients at the above stations. Moreover, *Closterium setaceum* and *Closterium timidum* were found only at station II which indicated fertility of the area.

Fertiliser was used for the turfed and landscaped area to ensure the grass and ornamental plants are growing well. Therefore, leaching of fertiliser during rain is expected which contributes to increased soluble nitrogen and phosphorus levels in the water which might influenced the composition of the phytoplankton (Anton & Abdullah, 1982). The average high concentration of ammoniacal nitrogen and average low concentration of dissolved orthophosphate at station III might be one of the most important factors influenced the composition of phytoplankton the station which had the highest number of species.

One-way and two-way ANOVA for species richness show that spatial factor contributed to significant difference between for at least one station with the others. However, the Shannon-Wiener's Index was not significantly different ($p < 0.05$) between the stations but they were significantly different based on the sampling occasions, due to influence of environmental variables.

Navicula sp. and *Trachelomonas* sp. were the most abundant species at each sampling occasions and stations. These two species were identified as pollutant-tolerant species (Tang & Phang, 2001). Moreover, the members of *Scenedesmus*, *Oscillatoria* and *Merismopedia* were also recorded in the lake which known to be adapted in polluted waters (Ashok, 2001). The presence of the pollution indicating species in the lake were due to the anthropogenic factors such as sewage and agrochemical inputs into the lake water during the construction stage.

5.3 Effect of environmental parameters on biotic variables

With reference to Table 5, conductivity had significant effect on the Shannon-Wirner's Index which may due to the ionic contents of the water. In addition, silica is also related to species richness and cell density of phytoplankton in the water. Besides that secchi depth also influenced the cell density indicating decreased light penetration in the water.

In cluster analysis, the stations were categorised into two major groups. Several similarities were noted between the classification of stations based on different sets of environmental and biotic variables. The dendrograms obtained from the cluster analysis (Figures 38 to 40) show the distinction between environmental and biotic variables between station I which was less polluted because of the wetland plants compared to stations II, III, IV and V.

5.4 General discussion

This study represents the first detailed research being carried out at the Lower Bisa area of Putrajaya Lake. Therefore, it provides valuable baseline data for future studies to be carried out and for comparison to assess the status of water quality and biotic variables in the area.

Based on the results, the lower Bisa area of Putrajaya Lake was under oligotrophic stage. Therefore, wetlands and lake management are important to ensure the water quality meets the Putrajaya Lake Water Quality Standard.

One of the fields worthwhile for future studies is the impact of land development on the distribution of phytoplankton in the Putrajaya Lake.

CHAPTER 6

CONCLUSION