OnLine Journal of Biologcial Sciences 1 (12): 1178-1182, 2001

Effect of Water Quality to Fish Abundance and Chlorophyll *a* (Selected Aquatic Organisms) in Labu River System, Malaysia

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Abstract: Determination of fish abundance and chlorophyll *a* concentration were carried out in Labu River System and two selected location at Langat River. Collection of fish specimen has been done between November 1999 and November 2000. Examination of chlorophyll *a* and several selected physico-chemical parameters were conducted from December 1999 to July 2000. The effect of water quality to the existence selected aquatic organisms was the main approach of this study. Twelve hardy species of fishes that tolerance with polluted environmental have been recorded. The obtained result indicates that abundance of fish is independent with pH and temperature. However, Total Suspended Solid (TSS), ammonia-nitrogen (NH_3-N) and dissolved oxygen (DO) have posed adverse impact on the distribution of fishes in the study ecosystem. Based on the Correlation Test performed shown linear correlation between chlorophyll *a* and pH was r = 0.42, temperature (r = 0.29), ammonium (NH_4^+) (r = 0.52), nitrite (NO_2^-) (r = -0.16), nitrate (NO_3^-) (r = -0.10), phosphate reactive (PO_4^{3-}) (0.39), phosphorus (P) (r = 0.39), sulphide (S^{2-}) (r = -0.07), sulpfate (SO_4^{2-}) (r = 0.63), calcium (Ca) (r = 0.63), cadmium (Cd) (r = 0.09), cuprum (Cu) (r = 0.32), ferum (Fe) (r = 0.30), magnesium (Mg) (r = 0.47), manganese (Mn) (r = 0.48), plumbum (Pb) (r = 0.43) and zinc (Zn) (r = -0.02). TSS has not reveal significant impact to the detectable level of chlorophyll *a* in aquatic system.

Key words: Labu River System, Langat River, fish abundance, Chlorophyll a

Introduction

The Labu River System that consists of Batang Labu, Labu and Batang Nilai plays as an important role in supply of water resource for catchment areas in Langat Basin which has a total area of 2938 km^2. This river system has experience adverse impact from deterioration of the environment. Rapid development of industrial, land clearance for infrastructure and agriculture fields, establishment of housing areas, elimination of forest has expedited the sedimentation and siltation. These circumstances have caused loss in biological diversity in the study area.

Anthropogenic pollutants originated from domestic activities, industrial processes, establishment of waste dumping site located near the confluence of Labu River System have contributed to the water pollution. Determination of the existence fish fauna and chlorophyll *a* level in rivers has allowed the quality of aquatic environment to be assessed. Appearance of fish species at particular location at riverine is influence by various factors, including physico-chemical parameters which usually affected by pollutants from anthropogenic sources. Detection of the primary interaction between toxicant and fish can serve as an early warning indicator. Thus, be of maximum predictive value in terms of protection of the whole population and ecosystem (Haux & Forlin, 1988). Fishes in aquatic system have been used widely as biological indicator for degree of pollution (Lloyd & Swift 1976; DOE 1997) and water quality (Price, 1979).

Fish are differing in their tolerance to amount, types of pollution (EPA, 2001) and environmental stresses. The ichthyofauna of the freshwater system of Southeast Asia is extremely diverse (Zakaria-Ismail, 1994). Distribution of fish species and tolerances to environmental stresses are well documented in the literature. These criteria have allowed fish to be used as one's of the biological indicator for monitoring the environmental quality.

Accurate quantification of chlorophyll *a* is an important step in estimating phytoplankton biomass (Simon & Helliwell, 1998) and productivity (Mantoura & Llewellyn 1983) in aquatic studies (Sartory & Grobbelaar, 1984). The chlorophyll *a* has been used to indicate the presence level of nutrient and physiological status of phytoplankton in the study area.

This study was conducted to investigate the effect of selected physico-chemical parameters to the abundance of fish and chlorophyll *a* (selected aquatic organisms) concentration in aquatic system.

The class and several beneficial uses based on Interim National Water Quality Standard (INWQS) of Malaysia are as listed below:

Class	Use
I	Conservation of natural environment Water supply I – practically no treatment necessary Fishery I – very sensitive aquatic species
IIA	Water supply II – conventional treatment required Fishery II - sensitive aquatic species
IIB	Recreational use with body contact
III	Water supply III – extensive treatment required Fishery III – Common and tolerant species Livestock drinking
IV	Irrigation
V	None of the above

Materials and Methods

Studies were carried on Labu River System and at two selected sites of Langat River. Eleven sites along Labu River System have been chosen. Two sites at Langat River also been selected to investigate the impact of Labu River System. Collection of fish specimens has been conducted between November 1999 and November 2000. Determination of chlorophyll *a* level and several selected physico-chemical parameters were monitored from December 1999 to July 2000. Sampling and analyses of water samples were based on standard methods proposed by American Public Health Association (APHA) 1995 (APHA, 1995) and Hach Manual 1998 (Hach 1998). Samplings were commenced from upperstream to downstream.

Physical parameters (conductivity, DO and pH) were measured *in-situ* using portable instrument (conductivity meter, DO meter and pH meter) that have been calibrated.

The Hach quick method based on DR/2010 was used to analyze NH_3-N (Nessler method), nitrate NO_2^- (Diazotization method), nitrate NO_3^- (Cadmium Reduction method), phosphate-phosphorus (acid ascorbic method), S^{2-} (Methylene Blue method) and SO_4^{2-} (SulfaVer 4 method). Total dissolved solid (TDS) and TSS were determined using APHA (1995) 2540C and APHA (1995) 2540D respectively.

Among the trace metals: Ca, Cd, Cu, Fe, Mg, Mn, Pb and Zn were analyzed according to APHA (1995) 3111B (direct air-acetylene method).

Method proposed by Santhanam *et al.* (1989) was employed to determine the level of chlorophyll *a* in the study aquatic system.

Fish were caught using net or electro shocker depending on the sampling areas. The time of shocking was 10 minutes. Ten time of net throwing was applied as a standard effect. Collected specimens were immediately fixed in 10% formalin on sites and kept in closed containers which contain 70% alcohol in laboratory prior identification.

This study was determining the influence of pollutants in water bodies on overall fish abundant in particular river sections. Richness or diversity of fish in the rivers was not investigated.

Data were analyzed by using Microsoft Office Excel 2000 statistical package on personal computer. Correlation Test was performed to show the relation of physico-chemical parameters on the selected aquatic organisms.

Results

Results obtained in this study were as listed and summarized in Table 1, Table 2, Table 3 and Table 4 according to the categories.

Fish: Twelve species of fish were recorded from the study area (Table 1). *Clarias batrachus*, *Hemirphodon tengah*, *Mystacoleucus marginatus*, *Puntius binotatus* and *Rosbora sumatrana* were in greater abundance than other species. The results obtained also shown only one species was found at St. SBN of Batang Labu River, St. 9 and St. 10 of Labu and two selected sites at Langat River (St. SLU and St. SLL) respectively.

An obvious decline trend in term of fish quantity and species were observed from upperstream to downstream. Upperstream of Labu River System exhibits larger individuals of fish compared to downstream. Differences average individual of fish from quantitative analysis were considerable.

Water Quality: The level of conductivity was ranged from 46.19 to 345.60 μScm^{-1}, DO (3.84 - 6.27 mg/l), pH (6.56 - 6.95) and temperature (25.42 – 28.64 °C). The average TDS and TSS concentrations of Langat Basin ranged from 348.06 to 512.25 mg/l and 31.31 to 344.75 mg/l respectively (Table 2).

The results obtained from analyses of nutrients using Spectrophotometer Hach DR 2010 revealed that the concentration of NH_3 ranged from 0.46 to 3.13 mg/l. The lowest level of NH_4^+ in aquatic system was 0.49 and highest at 3.31 mg/l, NO_2^- (0.026 – 1.205 mg/l), P (0.09 - 0.24 mg/l), PO_4^{3-} (0.28 - 0.74 mg/l) and NO_3^- (11.04 - 18.64 mg/l). The detected concentrations of SO_2^- and SO_4^{2-} in the water bodies were ranged from 0.012 to 0.019 mg/l and 4.44 to 68.88 mg/l respectively (Table 3).

Analysis of trace metals (Table 4) showed that of Ca recorded from the rivers ranged from 1.215 to 4.739 mg/l. The average concentration of Cd that observed was ranged from 0.022 to 0.042 mg/l, Cu (0.340 - 0.575 mg/l), Fe (0.324 m/l - 0.535 mg/l) and Mg (0.605 – 1.525 mg/l). The average level of Mn and Pb were ranged from 0.027 to 0.045 mg/l and 0.219 to 0.325 mg/l respectively. The highest level of Zn detected in aquatic system was 0.037 mg/l and lowest at 0.058 mg/l.

Chlorophyll a: The concentration of chlorophyll *a* on the study area ranged from 1.5069 to 2.4212 μg/l (Table 3). St. 4 has obtained the lowest level (1.5069 μg/l) of chlorophyll *a* and highest at St. SBN (2.4212 μg/l). The chlorophyll *a* concentration measured at St. SBN and St. 8 were exceeded 2.000 μg/l.

Discussion

Fish: The numbers individual of fish species collected in the thirteen sampling sites were influenced by physico-chemical characteristics of water quality. Downstream of Labu River System and at two selected locations of Langat River have shown adverse effect from anthropogenic pollutants based from the recorded result (Table 1). Species of fish that were only tolerance with polluted environment was able to live in the study river system.

Aerobic decomposition of nitrogen containing organic compounds by microbes occurring in municipal wastewater discharges (Twort, *et al.* 1974; Vega *et al.* 1998), effluent released from community waste (Chapman 1992) was depleted dissolved oxygen in the water bodies. DO in the water bodies may be depleted during conversion of ions from a lower reductive state to higher oxidative state (Norris & Charlton 1962). The presence of DO is of prime importance to most members of the aquatic community (Flick 1974). A minimum constant DO value of 5 mg/l (Alabaster & Lloyd, 1982) or remain above 5 mg/l (Jain *et al.*, 1977) would be satisfactory for most stages and activities in the life cycle for freshwater fish or tropical biota. DO levels along the rivers of Labu River System except selected locations of Langat River were within INWQS threshold level (3-5 mg/l) to support common and tolerant aquatic species. The Correlation Test performed shown the availability of DO ($r = 0.78$) was not a significant limitation for the survival of fish.

The average level of conductivity, pH, and TDS along the rivers was within INWQS recommended limit to support the aquatic life. The temperature measured in the rivers was within the normal range of water temperature for Malaysian rivers. Statistical test revealed that *in-situ* properties (conductivity, DO and pH) and TDS in the streams have not pose significantly effect on the distribution of fish.

The concentration of TSS measured during this study shown most sections of Labu River System and selected sites on Langat River were exceeded INWSQ threshold value to support aquatic life. The death rate among fish living in waters over long periods with level of SS high than 200 mg/l has been observed (Alabaster & Lloyd, 1982). This circumstance would explain the low abundance of fish in Batang Nilai, downstream of Labu River System and Langat River.

The effect of NH_3 on fish is an important factor to be considered. NH_3 refers to the combined concentration of un-ionized (NH_3) and ionized ammonia (NH_4^+). The acute lethal concentrations of NH_3 for a variety of fish species lie in the range of 0.2-2.0 mg/l (Alabaster & Lloyd 1982). The average concentration of NH_3 at the upperstream of Labu River System was below the maximum limit (2.0 mg/l) proposed by Alabaster & Lloyd (Alabaster & Lloyd, 1982). However, NH_3 concentration recorded along the rivers was exceeded the

Table 1: Number of individuals for all fish collected at study area. Species are listed by rank order of numerical abundance. Observations were based on 6 replicates. The abbreviation 'St.' refers to station.

Species	St. No. and Number of Individuals												
	1	2	3	4	5	6	SBN	7	8	9	10	SLU	SLL
Betta anabatoides	3	0	1	1	0	0	0	0	0	0	0	0	0
Channa murulioides	1	2	0	0	0	2	0	1	0	0	0	0	0
Clarias batrachus	2	12	21	31	4	8	0	1	0	0	0	0	1
Hemirphodon tengah	24	0	0	3	7	2	0	0	0	0	0	0	0
Monopteus albus	1	0	1	0	0	0	0	0	0	0	0	0	0
Mystacoleucus marginatus	21	19	21	8	3	4	0	0	0	0	0	0	0
Mystus nemurus	0	0	0	0	0	0	0	0	0	0	0	1	0
Oreochromis mossambicus	0	0	0	0	0	0	3	4	21	0	1	0	0
Poecilia reticulatus	1	1	0	0	0	0	0	0	0	0	0	0	0
Puntius binotatus	66	27	57	17	7	15	0	4	3	0	0	0	0
Rosbora sumatrana	44	7	15	1	8	15	0	10	0	0	0	0	0
Trichogaster trichopterus	0	0	1	0	0	1	0	0	0	0	0	0	0

Table 2: Mean and standard deviation (±) of the in-situ and physicals parameters of the study area. Observation were based on 16 replicates. The abbreviation 'St.' refers to station.

	Conductivity (μScm^{-1})	Do (mg^{-1})	pH (mg^{-1})	Temperature (°C)	TDS (mg^{-1})	TSS (mg^{-1})
1	46.19±4.11	6.27±0.64	6.72±0.23	25.42±432.10	463.31±432.10	31.31±33.97
	(38.90-55.70)	(5.10-7.20)	(6.25-7.14)	(23.50-28.70)	(46.00-1405.00)	(1.00-100.00)
2	60.98±9.63	5.63±0.51	6.77±0.27	27.08±1.11	452.44±358.60	73.56±56.43
	(48.90-87.20)	(4.80-6.50)	(6.15-7.26)	(24.50-28.70)	(68.00-1124.00)	(11.00-224.00)
3	51.98±14.67	5.42±0.69	6.74±0.21	26.69±0.95	384.00±410.58	67.13±39.72
	(0.20-65.00)	(4.30-6.60)	(6.42-7.12)	(24.40-28.30)	(103.00-1321.00)	(6.00-156.00)
4	72.58±75.01	5.35±0.65	6.69±0.29	26.74±0.99	389.56±356.80	84.94±61.33
	(46.70-353.40)	(4.00-6.40)	(5.99-7.14)	(24.60-28.30)	(20.00-1183.00)	(10.00-206.00)
5	56.39±9.22	5.44±0.63	6.56±0.23	26.23±0.76	483.06±454.94	74.31±54.69
	(37.20-80.10)	(4.50-6.60)	(6.18-6.97)	(24.40-27.40)	(66.00-1682.00)	(13.00-204.00)
6	62.39±9.60	5.94±0.54	6.83±0.29	27.32±0.84	365.88±417.06	160.25±217.32
	(44.40-86.70)	(5.10-6.90)	(6.23-7.48)	(25.60-28.50)	(24.00-1723.00)	(17.00-880.00)
SBN	345.60±101.80	3.84±1.09	6.95±0.29	28.63±1.16	380.88±315.87	184.94±165.20
	(156.30-522.00)	(2.30-5.90)	(6.51-7.71)	(26.40-30.20)	(80.00-1269.00)	(18.00-563.00)
7	157.29±91.42	5.14±0.94	6.93±0.32	27.70±1.00	478.44±418.68	116.00±84.45
	(60.00-382.00)	(3.60-6.60)	(6.48-7.73)	(25.80-29.50)	(92.00-1646.00)	(24.00-330.00)
8	151.79±82.59	5.14±0.90	6.83±0.48	27.68±0.96	420.56±440.04	157.19±166.20
	(19.60-348.00)	(3.30-6.40)	(5.64-7.79)	(25.50-29.00)	(43.00-1680.00)	(22.00-688.00)
9	152.97±64.80	4.85±0.64	6.56±0.56	28.26±1.46	420.47±487.98	152.60±108.22
	(71.60-286.00)	(3.20-5.60)	(5.41-7.30)	(24.50-29.80)	(41.00-1766.00)	(12.00-375.00)
10	182.53±90.43	4.63±0.81	6.72±0.76	28.64±1.25	512.25±489.14	174.50±118.44
	(74.30-386.00)	(2.90-6.10)	(5.73-9.25)	(26.40-30.30)	(25.00-1942.00)	(50.00-374.00)
SLU	92.38±62.89	5.23±0.74	6.72±0.28	28.40±1.45	348.06±230.19	344.75±257.10
	(27.70-267.00)	(4.30-6.70)	(6.24-7.16	(24.30-31.30)	(26.00-844.00)	(52.00-945.00)
SLL	127.49±74.05	4.59±0.71	6.63±0.35	28.31±0.91	371.44±291.00	278.63±219.11
	(37.20-289.00)	(3.60-5.80)	(5.98-7.26)	(26.60-29.70)	(13.00-883.00)	(51.00-799.00)

threshold limit proposed by the INWQS (0.9 mg/l), yet neither acute nor lethal effect remains unknown since the concentration of NH_3 on the river is influenced by pH and temperature. On the other hand, fish differ slightly in their tolerance to NH_3 which depending on species stage of life cycle and the types of pollutants. The result from Correlation Test shown abundance of fish along the rivers was reverse correlated ($r = -0.68$) to the increasing level of NH_3 in aquatic system.

Among the studied trace metals, Cd and Cu were recorded the levels above INWQS threshold value. The behaviour characteristic of fish and presence of soluble metal salts in short periods do not appear to harm fish.

Chlorophyll a: Primary productivity that referring to chlorophyll *a* in an aquatic environment is dependent on light energy, nutrients, carbon dioxide (Saravanamuthu & Lim, 1982) and temperature (Schwoerbel 1987). Distribution of algae was promoted by wind action and slow flow rate. The movement and flow rate of the water have no direct effect on photosynthesis but absorption of nutrient is promoted in a flowing water (Schwoerbel, 1987). The results of this study showed an almost uniform concentration of primary production along the rivers (Table 3). Phytoplankton in the study rivers may carried by flowing water and distributed to the nearby river sections

In-situ parameters (pH and temperature) and intensity of light measured along the rivers were not the limiting factors inhibited photosynthesis in the aquatic system. The results acquired from the Correlation Test between chlorophyll *a* with pH was $r = 0.42$ and temperature ($r = 0.29$). Several factors influence water temperature, which included location and time

Table 3: Mean and standard deviation (±) of nutrients parameters of the study area. Observations were based on 16 replicates. The abbreviation 'St.' refers to station.

St. No.	NH_3 (mg^{-1})	NH_4 (mg^{-1})	p (mg^{-1})	PO_4^{3-} (mg^{-1})	NO_2^- (mg^{-1})	NO_3^- (mg^{-1})	S^- (mg^{-1})	SO_4^{2-} (mg^{-1})	Chlorophyll a (μg^{-1})
1	0.46±0.23	0.49±0.24	0.13±0.15	0.41±0.45	0.026±0.012	11.04±4.36	0.012±0.006	4.44±4.27	1.7865±1.2337
	(0.13-0.97)	(0.14-+1.03)	(0.02-0.64)	(0.07-1.95)	(0.007-0.049)	(6.60-23.00)	(0.003-0.026)	(1.00-17.00)	(0.0713-4.6245)
2	0.69±0.22	0.74±0.23	0.22±0.25	0.67±0.78	0.051±0.040	12.57±5.81	0.17±0.013	5.00±3.71	1.5369±1.0226
	(0.36-1.07)	(0.39-1.13)	(0.04-0.93)	(0.12-2.85)	(0.016-0.190)	(8.40-27.90)	(0.003-0.061)	(1.0-16.00)	(0.1284-2.9023)
3	0.68±0.23	0.72±0.25	0.19±0.13	0.57±0.39	0.051±0.024	13.20±4.87	0.017±0.008	6.00±4.89	1.8126±0.9749
	(0.40-1.28)	(0.43-1.35)	(0.04-0.43)	(0.12-1.31)	(0.023-0.115)	(8.90-29.20)	(0.002-0.039)	(2.00-23.00)	(0.3055-3.0000)
4	0.55±0.20	0.59±0.21	0.15±0.20	0.47±0.62	0.051±0.028	13.89±4.50	0.017±0.008	6.19±5.26	1.5069±0.9076
	(0.32-1.06)	(0.33-1.12)	(0.02-0.85)	(0.07-2.62)	(0.013-0.115)	(9.30-27.00)	(0.003-0.030)	(2.00-24.00)	(0.1006-2.9388)
5	0.56±0.18	0.60±0.19	0.18±0.15	0.55±0.47	0.063±0.067	14.91±5.43	0.017±0.009	7.50±7.06	1.6854±0.7678
	(0.32-0.92)	(0.33-0.98)	(0.03-0.46)	(0.10-1.40)	(0.026-0.296)	(10.60-31.00)	(0.005-0.035)	(1.00-31.00)	(0.6830-2.9408)
6	0.46±0.20	0.49±0.21	0.09±0.06	0.28±0.17	0.040±0.020	14.09±3.77	0.015±0.009	7.81±6.23	1.7359±0.7446
	(0.24-0.91)	(0.26-0.97)	(0.03-0.20)	(0.08-0.60)	(0.013-0.082)	(8.40-21.70)	(0.001-0.032)	(2.00-26.00)	(0.1161-2.7138)
SBN	3.13±1.11	3.31±1.17	0.24±0.31)	0.74±0.95	0.131±0.123	14.23±4.37	0.017±0.013	68.88±31.73	2.4212±1.6510
	(1.24-4.99)	(1.31-5.28)	0.01-1.06)	(0.03-3.25)	(0.013-0.443)	(9.30-24.80)	(0.002-0.051)	(29.00-139.00)	(0.3365-6.5590)
7	1.37±0.80	1.45±0.85	0.16±0.23	0.50±0.71	0.063±0.034	14.23±4.37	0.016±0.009	32.56±15.48	1.5139±0.8404
	(0.46-3.47)	(0.49-3.67)	(0.02-0.99)	(0.06-3.05)	(0.020-0.141)	(9.30-24.80)	(0.004-0.036)	(7.00-68.00)	(0.1788-2.8983)
8	1.76±1.20	1.86±1.27	0.16±0.20	0.48±0.60	0.098±0.084	13.26±3.60	0.017±0.011	26.50±9.32	2.0497±0.9254
	(0.47-4.62)	(0.50-4.89)	(0.01-0.84)	(0.04-2.57)	(0.023-0.322)	(8.90-21.20)	(0.003-0.040)	(18.00-50.00)	(1.0828-4.9948)
9	2.01±1.36	2.13±1.44	0.17±0.16	0.53±0.49	0.812±0.918	15.44±5.97	0.017±0.007	25.87±8.56	1.7088±1.1571
	(0.38-5.27)	(0.40-5.58)	(0.02-0.63)	(0.06-1.92)	(0.099-3.251)	(8.40-29.70)	(0.007-0.034)	(9.00-48.00)	(0.0830-4.2213)
10	2.58±2.00	2.73±2.12	0.18±0.17	0.55±0.54	1.205±1.263	18.64±6.92	0.019±0.010	32.50±10.52	1.6062±0.6991
	(0.80±7.48)	(0.85-7.92)	(0.02-0.68)	(0.06-2.10)	(0.105-4.056)	(9.70-31.40)	(0.009-0.039)	(13.00-52.00)	(0.7633-2.6405)
SLU	1.40±1.36	1.49±1.44	0.22±0.34	0.67±1.04	0.135±0.088	15.16±5.65	0.015±0.007	20.06±13.38	1.9513±0.9916
	(0.33-4.86)	(0.35-5.15)	(0.03-1.40)	(0.08±4.30)	(0.036-0.325)	(8.90-27.40)	(0.005-0.030)	(7.00-61.00)	(0.7240-4.2486)
SLL	1.76±1.54	1.86±1.63	0.18±0.15	0.54±0.47	0.276±0.229	14.06±4.83	0.016±0.008	24.50±13.51	1.6230±0.9035
	(0.54-6.36)	(0.57-6.74)	(0.04-0.59)	(0.12-1.80)	(0.105-1.077)	(8.40-27.90)	(0.003-0.034)	(8.00-56.00)	(0.2809-2.9820)

Table 3: Mean and standard deviation (±) of nutrients parameters of the study area. Observations were based on 16 replicates. The abbreviation 'St.' refers to station.

St. No.	Parameter							
	Ca (mg^{-1})	Cd (mg^{-1})	Cu (mg^{-1})	Fe (mg^{-1})	Mg (mg^{-1})	Mn (mg^{-1})	Pb (mg^{-1})	Zn (mg^{-1})
1	2.280±1.940	0.029±0.020	0.450±0.267	0.356±0.237	1.013±0.678	0.027±0.016	0.292±0.168	0.040±0.012
	(0.080-6.242)	(0.006-0.085)	(0.179-0.988)	(0.133-0.839)	(0.061-2.652)	(0.012-0.058)	(0.091-0.697)	(0.015-0.060)
2	2.338±1.184	0.042±0.031	0.480±0.242	0.398±0.340	0.837±0.615	0.037±0.018	0.289±0.159	0.043±0.016
	(0.143-4.685)	(0.017-0.096)	(0.239-0.988)	(0.072-1.032)	(0.076-2.769)	(0.017-0.065)	(0.091-0.649)	(0.021-0.077)
3	2.323±1.372	0.033±0.024	0.480±0.251	0.391±0.279	0.745±0.748	0.031±0.016	0.313±0.119	0.039±0.013
	(0.143-4.143)	(0.012-0.096)	(0.239-0.988)	(0.072-1.000)	(0.061-3.322)	(0.012-0.060)	(0.091-0.450)	(0.014-0.068)
4	1.215±1.023	0.022±0.012	0.520±0.306	0.324±0.235	0.605±0.300	0.032±00.019	0.219±0.135	0.040±0.016
	(0.143-3.000)	(0.006-0.059)	(0.006-0.988)	(0.072-0.938)	(0.105-1.197	(0.012-0.072)	(0.091-0.394)	(0.013-0.077)
5	1.534±1.317	0.028±0.012	0.340±0.226	0.357±0.236	0.747±0.398	0.032±0.016	0.291±0.166	0.039±0.016
	(0.143-3.700)	(0.012-0.054)	(0.006-0.757)	(0.133-0.839)	(0.250-1.677)	(0.014-0.058)	(0.091-0.697)	(0.019-0.068)
6	1.944±1.367	0.031±0.018	0.455±0.313	0.420±0.289	0.815±0.360	0.033±0.017	0.308±0.115	0.042±0.016
	(0.143-4.217)	(0.012-0.075)	(0.006-0.988)	(0.133-1.029)	(0.322-1.852)	(0.012-0.058)	(0.091-0.397)	(0.013-0.077)
SBN	4.739±4.981	0.033±0.017	0.546±0.273	0.535±0.264	1.476±1.348	0.045±0.020	0.320±0.148	0.047±0.019
	(0.143-21.470)	(0.020-0.075)	(0.237-0.988)	(0.133-0.899)	(0.687-6.349)	(0.022-0.072)	(0.091-0.697)	(0.018--0.085)
7	3.207±1.574	0.025±0.015	0.508±0.252	0.531±0.277	1.151±0.898	0.034±0.017	0.283±0.144	0.045±0.019
	(0.498-5.857)	(0.001-0.054)	(0.121-0.988)	(0.193-1.036)	(0.250-3.584)	(0.014-0.062)	(0.091-0.532)	(0.019-0.077)
8	2.662±1.280	0.022±0.008	0.565±0.270	0.408±0.246	1.141±0.515	0.035±0.022	0.296±0.177	0.037±0.010
	(0.143-4.429)	(0.006-0.033)	(0.239-0.988)	(0.33-0.980)	(0.288-2.274)	(0.012-0.067)	(0.091-0.697)	(0.021-0.060)
9	1.818±1.048	0.036±0.032	0.575±0.214	0.516±0.249	1.525±0.924	0.037±0.019	0.319±0.138	0.045±0.018
	(0.143-3.071)	(0.017-0.138	(0.239-0.931)	(0.193-0.995)	(0.134-3.933)	(0.014-0.065)	(0.091-0.600)	(0.023-0.085)
10	1.936±0.512	0.032±0.033	0.523±0.300	0.481±0.236	1.239±0.700	0.039±0.020	0.325±0.186	0.058±0.030
	(1.426-3.000)	(0.017-0.154)	(0.179-0.988)	(0.193-0.969)	(0.061-2.769)	(0.017-0.072)	(0.091-0.697)	(0.028-0.140)
SLU	2.42±1.456	0.036±0.036	0.526±0.275	0.390±0.39	0.979±0.543	0.040±0.021	0.298±0.111	0.047±0.020
	(0.143-6.485)	(0.006-0.143)	(0.239-0.988)	(0.072-0.983)	(0.483-2.332)	(0.012-0.074)	(0.091-0.394)	(0.019-0.094)
SLL	3.386±4.977	0.026±0.017	0.451±0.253	0.345±0.293	0.937±0.366	0.038±0.018	0.298±0.157	0.042±0.017
	(0.143-20.915)	(0.006-0.069)	(0.179-0.988)	(0.072-0.939)	(0.221-1.590)	(0.017-0.067)	(0.091-0.697)	(0.019-0.068)

of sampling. Higher water temperature recorded at downstream of Labu River System and selected locations of Langat River were influenced by sampling time. The samples collection for water quality at mentioned river sections were conducted during noon.

The level of TSS in the aquatic system has not posed a significant effect on the concentration of chlorophyll *a* although TSS was higher at middle section and downstream of Labu River System. The observed trend suggested that nutrients have exhibit significant effect on phytoplankton compared to TSS.

The concentration of nitrogen and phosphorus are often low enough to limit phytoplankton growth in surfaces waters (Darley, 1982). However, the obtained results from analysis of water quality samples revealed that nitrogen and phosphorus may not the inhibit factor for development and multiplication of phytoplankton in the study rivers. Most algae utilize NO_3^-, NO_2^- or NH_4^+ (Graham, 2000). The Correlation Test that performed to relate concentration level of chlorophyll *a* with NO_2^- showed anti-correlation was obtained. The results obtained indicate that NH_4^+ was positive correlated ($r = 0.52$) than NO_3^- ($r = -0.10$). NH_4^+ is preferred over NO_3^- to the extent that NH_4^+ concentration above 0.5-1.0 μmoll^{-1} will inhibit uptake of NO_3^-. Conversion of NO_3^- to NH_4^+ requires energy and nitrate reductase enzyme (Graham & Wilcox, 2000). The mechanism involved explains the high correlation between chlorophyll *a* and NH_4^+. The negative linear relation between chlorophyll *a* and NO_2^- ($r = -0.16$) may due to the level of NO_2^- is not as abundant in natural waters compare to other forms of fixed nitrogen (Darley, 1982).

The statistical test also revealed that PO_4^{3-} and P has shown positive relation ($r = 0.39$) with chlorophyll *a*. Sulfur is required by algae for biosynthesis of cysteine and methionine. In addition, it is required for S-containing thylakoid lipids (Graham & Wilcox, 2000). SO_4^{2-} was higher correlated ($r = 0.63$) with chlorophyll *a* compared to S^{2-} ($r = -0.07$) which may due to low concentration of S^{2-} presence in the study watercourses.

Based on the statistical results obtained from Correlation Test, all analyzed trace metals except Zn were positive correlated with chlorophyll *a*. The correlation between chlorophyll *a* and Ca was r=0.63, Cd (r=0.09), Cu (r=0.32), Fe (r=0.30), Mg (r=0.47), Mn (r=0.48) and Pb (r=0.43). However, weak correlation between chlorophyll *a* and Zn (r=-0.02) was observed. The positive values obtained from Correlation Test indicate that phytoplankton was not experience adverse effect with the presence of trace metals. However, there is too little information available for trace elements required. Deficiency of certain trace elements such as Fe and Mn have been proven inhibits photosynthesis and the multiplication rate falls (Schwoerbel, 1987).

The environment of Labu River System and selected sites at Langat River possed an expedient condition for phytoplankton community. The uniform trend of chlorophyll *a* level which observed in the aquatic system is promoted by a flowing water. However, the abundance of fish community is largely influenced by physico-chemical characteristics of water quality. Slow flow rate and insufficient of vertical turbulence at the study area have affected the rate of dispersal and dilution of anthropogenic pollutants which originated from domestic waste, agriculture fields and dumping site that located near the river bank of Labu River.

The obtained results from analytical work revealed that Langat River has experience direct adverse impact of the waterborne pollutants from Labu River. Labu River also has exposure to the same risk from Batang Nilai River.

Development of phytoplankton is largely determined by nutrients whilst DO, NH_3-N and TSS pose an key factors for the existence of fish community.

Labu River System and selected sites at Langat River were considered to be unsuitable to support sensitive aquatic life in long terms.

Acknowledgements

The authors wish to thank laboratory staff at University Kebangsaan Malaysia for their kind and support during the collection, storage and transport of the specimens.

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