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Effect of River Discharge Fluctuation on Water Quality at Three Rivers in Endau Catchment Area, Kluang, Johor.

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Abstract: The water quality and river discharges was surveyed at three rivers in Endau cathment area (Sungai Dengar, Madek and Mengkibol) which was located in Kluang, Johor from November 2008 to August 2009 by using in-situ water quality measurement instruments and current meter. In-situ water quality measurement instruments were used to measure water quality and current meter was used to measure river water discharges. A total of five water quality parameters were measured namely pH, dissolved oxygen, conductivity, temperature and turbidity. Based on the results, it shows that there is a negative relationship between the values of all water quality variables measured (except turbidity) and discharge. Here we can suggest that, high water discharge will not influence the concentrations of pH, dissolved oxygen, conductivity and temperature except turbidity. Water becomes more turbid with the increased volume of water or with the increased of water discharge and clearer or less turbid during low water.

Key words:

INTRODUCTION

A. Fatimah and M. Zakaria-Ismail (2005) stated that fresh water is a precious commodity. Water is the essence of life. The demand for clean and portable water has increased tremendously due to rapid development and a growing population. The demand is not only for human beings but also for aquatic life that use water or river as their habitats and this aquatic life eventually become a protein source for humans. Thus it is imperative that every effort should be made to protect and conserve existing water resources, namely our rivers, for present and future needs. Water is the basic resource upon which society relies for the quality of its life, including its health and recreation. It is also the primary resource upon which social and economic developments are based and sustained. Aquatic ecosystems must, therefore, be effectively protected and managed to ensure that they retain their inherent vitality and remain fit for domestic, industrial, agricultural and recreational uses, for present and future generations.

Brandvold, *et. al.* (1976) stated that water quality parameters can be divided in to two major groups namely physical and chemical. An example of physical parameters are total suspended solids (TSS), temperature, colour and turbidity. Example of chemical parameters are dissolved oxygen (DO), biochemical oxygen demand (BOD), chemical oxygen demand (COD), conductivity, pH, ammoniacal nitrogen (AN), nitrate and phosphate. River water quality status was determined by surrounding sources or surrounding land use. There were a number of studies and papers presented using chemical and physical parameters to determine surface water quality. Among others was a study done by Da Silva and Sacomani (2001), Hun-Kyun, *et. al.* (2009), Durmishi, *et. al.* (2008) and Basualto, *et. al.* (2006).

Fatimah and Zakaria-Ismail (2005) did a water quality sampling for Selai river which is also situated in Endau Catchment area and this river can be categorized as Class I river. They also suggested that, good water quality recorded in Sungai Selai is probably due to the strong buffering capacity of the soil from which the river passes through. A similar studies was carried out by a number of researchers around the globe to measure physico-chemical parameters for water quality such as Naoki and Takeshi (2003), Delfino (1977),

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Indra Bhangu and Paul (1998), Kingdon, *et. al.* (1999), Chapman (1996), Haiyan, *et. al.* (2006), Elexova and Nemethova (2003), Morse, *et. al.* (2003) and Ahmet, Kadri, and Fazli (2005). Only few researchers that embarked on the study to determine relationship between river discharge and water quality. One of them is Kurunc, Yurekli and Ozturk (2005). They did the study on determining the effect of discharge fluctuation on water quality variables from the Yesilirmak River.

MATERIALS AND METHODS

Study Site:

This study was conducted within the Endau Catchment areas in the District of Segamat, Kluang and Mersing in the state of Johor (Figure 1). The main river of these catchments is Sungai Sembrong which is supported by several tributaries such as Sungai Madek, Sungai Mengkibol and Sungai Dengar. River tributary that was selected for study sites is in Order 2 to 3. Three stations were selected from three different rivers, one station from each river, namely Sungai Dengar, Sungai Madek and Sungai Mengkibol for studying the physical and chemical conditions of water quality and river discharge.

River gauging were used to measure river discharge and for the purpose of this study, river gauging station was at the same station with water quality station. Two modes of water sampling was obtained, which was in-situ measurement and water sampling for laboratory analysis.

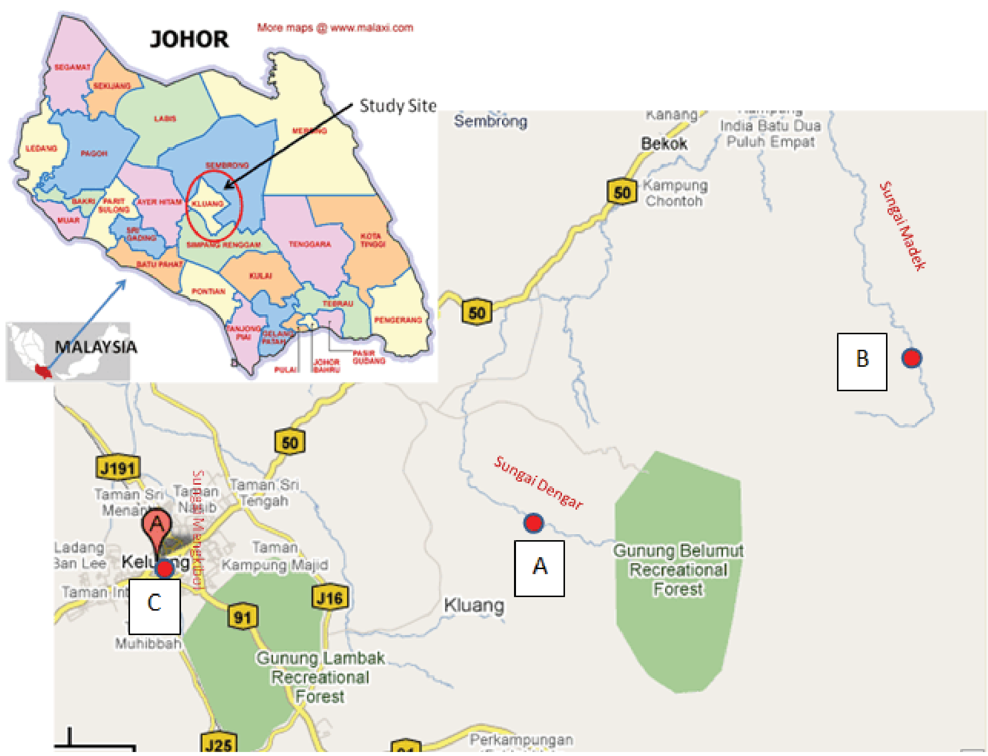

Fig. 1: Sampling Stations at Sungai Mengkibol, Madek and Dengar

Methods:

Data were collected for 4 times between the periods from November 2008 till August 2009. At each station, five parameters were measured following the standard procedure of U.S. Environmental Protection Agency (2007). Temperature, Conductivity, Dissolved Oxygen (DO), pH and Turbidity were measured by using a multi parameters probe Model YSI 6920 with 650 MDS Display/Logger as well as single parameter probe was used for in-situ measurement of river water quality. The YSI 650 Multi-parameter Display System (650 MDS) is a hand held microcomputer based instrument that allows the user to display sonde readings, configure sondes, store and recall data, upload data from sondes and transfer data to computers for analysis and plotting. The YSI 6920 Multi-parameter Probe measures the water quality. This probe comprises six (6) sensors to measure six (6) parameters namely DO, Salinity, Conductivity, Ammoniacal Nitrogen, Temperature and pH. Even though the YSI 6920 multi parameters probe model was used to measure water quality but single parameter probe instruments was also used for turbidity parameter that was not in the multi-parameter probe and also as a back-up instruments. Yellow Springs Instrumentations (YSI) Model 85 Handheld for DO/Conductivity Meter to measure DO, Conductivity, and Temperature. Yellow Springs Instrumentations (YSI) Model 55 Handheld for DO. Yellow Springs Instrumentations (YSI) Model 30 Handheld for Conductivity (Washington State Department of Ecology, 2006). Portable Turbiditimeter Hanna Model 2100P to measure turbidity of the water. Hand held pH Meter Consort Model C535 to measure water pH. All the readings were recorded in the field sampling form on site before analyses. Collected data was then key-in to the computer and analyze.

River discharges were measured following the standard procedure of Drainage and Irrigation Department of Malaysia (1995). The instruments involved in this measurement were flow meter, float, measuring tape, marked string as well as field form and also observation. Flow meter was used to measure velocity, discharge and cross section of the river but in the circumstances where flow meter or current meter out of order, float method was used as a back-up. Valeport 'Braystoke' Model 001 Flow Meter was used to gauge the river. River gauging was conducted in each sampling site to identify river cross section, water depth measurement and river discharge. But during the second sampling task which was between 20 – 22 March 2009 for all that stations and third sampling task which was on the 18 June 2009 at Madek River station, Float Method was used to measure river discharge. This was due to Valeport 'Braystoke' Model 001 Flow Meter was out of order.

A measuring tape or tag line was stretched across the river at right angles to the direction of flow using 20 to 30 verticals; the spacing of these was determined to ensure that no segment contains more than 10% of the total discharge. An approximately discharge for this purpose can be obtained from the stage-discharge curve or from previous current meter measurement but for the purpose of this study the real time discharge was measured. The positions of successive verticals used for depth and velocity was located by horizontal measurements from a reference marker (initial points) on the bank, defined by a stick. The gauging starts at the water edge of the near bank, where depth and velocity, may or may not be zero. At each chosen vertical the depth is measured and the value used to compute the setting or settings of the current meter depending on the method to be used (usually 0.6 or 0.2 and 0.8 depth). After the meter is in position the rotor is allowed to adjust to the stream velocity before the count of rotor revolution is started – this may take only a few seconds where velocities are over about 0.3 m/s but a longer period is necessary of lower velocities. A revolution count was than taken at each selected point for a minimum of 60s, noting the revolutions count at the end of each 1 minute period. The position of operator is important to ensure that the operator's body does not affect the flow pattern at or approaching the current meter. The best position is to stand facing one or other of the banks, slightly downstream of the meter and an arm's length from it. The rod is kept vertical throughout the measurement with the meter parallel to the direction of flow. But myself standing slightly downstream of the meter and facing upstream with the rod was kept vertical at all time, this is to speed up the measurement due to time constrain.

While for the float method, a tag line was stretched along the river for at least 10 meter length. There were three operators working on it, one operator release the float, the other one keep the time when the float passed the first point and stop the time when the float passed the second point and the last operator will catch the float to prepare for the next float release. Four reading for each station was measured and an average of the reading was computed. Velocity of the river flow was computed by dividing the pre-measured distance with the average time for the float to passed pre-measured distance. Usually, a diminished coefficient is necessary. For relatively deep streams, 0.8 is a common coefficient, but for shallow streams, it may fall below 0.7. Width and length of the river reach was measured by using measuring tape. The product of cross-sectional area and velocity is equal to the discharge. $Q = AV$, where A is a cross-sectional area and V represent velocity.

RESULTS AND DISCUSSION

Below are the results obtained from the study conducted from November 2008 until August 2009 which comprises of four sampling frequency. The results were presented in the form of line graph.

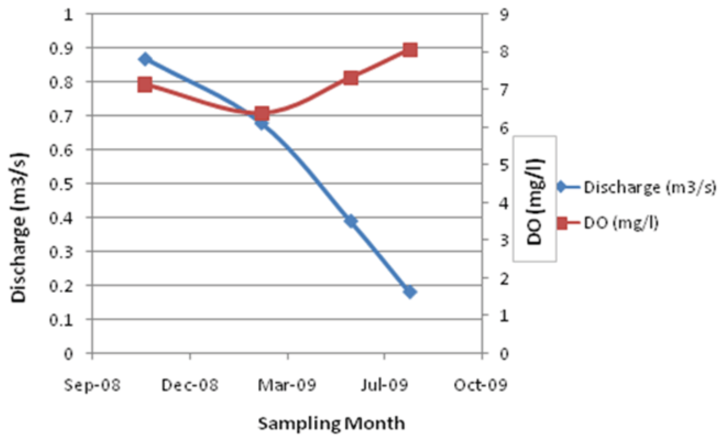

Fig. 1a: Relationship between dissolved oxygen and discharge at Sungai Dengar

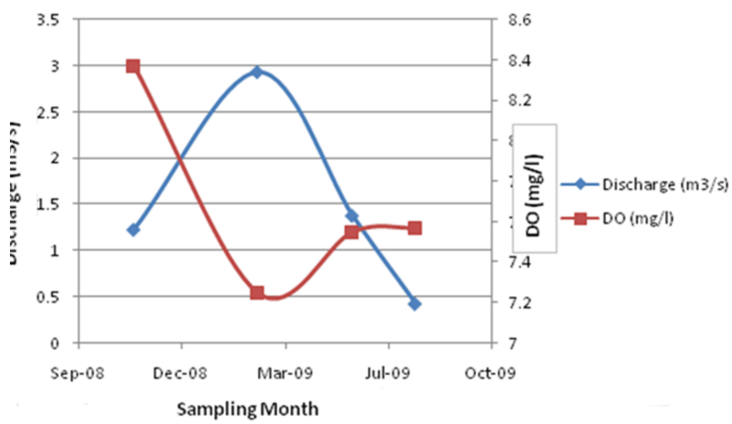

Fig. 1b: Relationship between dissolved oxygen and discharge at Sungai Madek

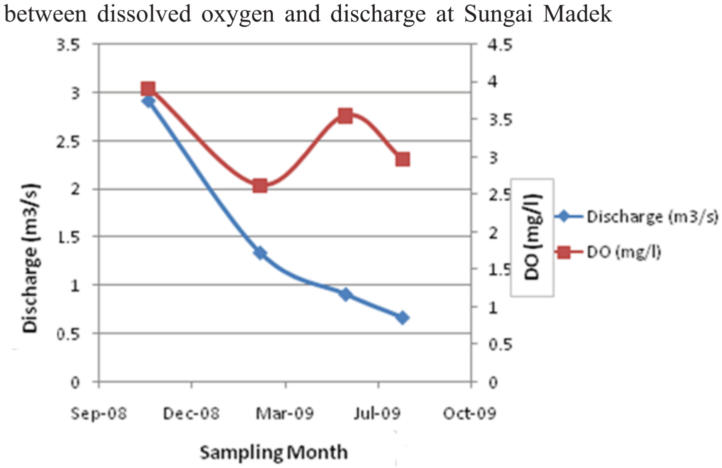

Fig. 1c: Relationship between dissolved oxygen and discharge at Sungai Mengkibol

Figure 1a – 1c shows the relationship between dissolved oxygen and discharge at Sungai Dengar, Madek and Mengkibol respectively. Figure 1a – 1c have shown a negative relationship between river discharges and dissolved oxygen (DO) concentrations, where high water discharges have a lower DO concentrations and vice-versa.

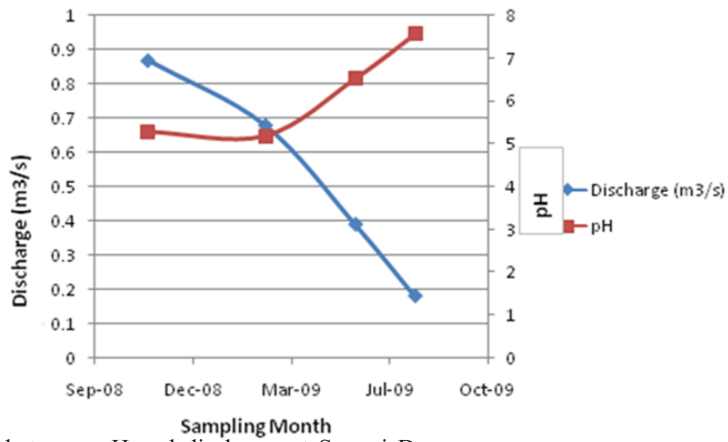

Fig. 2a: Relationship between pH and discharge at Sungai Dengar

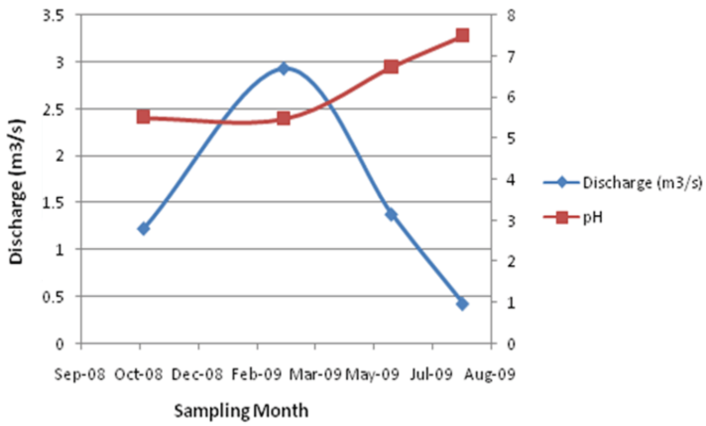

Fig. 2b: Relationship between pH and discharge at Sungai Madek

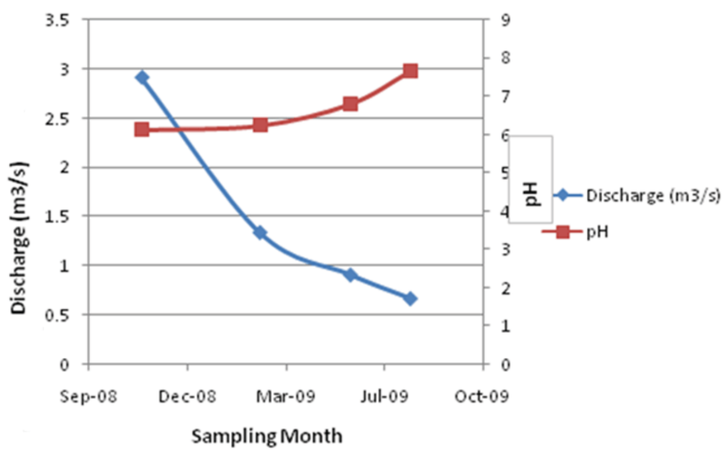

Fig. 2c: Relationship between pH and discharge at Sungai Mengkibol

Figure 2a – 2c shows the relationship between pH and discharge at Sungai Dengar, Madek and Mengkibol respectively. Figure 2a – 2c have shown a negative relationship between river discharges and pH, where high water discharges have a lower pH concentrations and vice-versa.

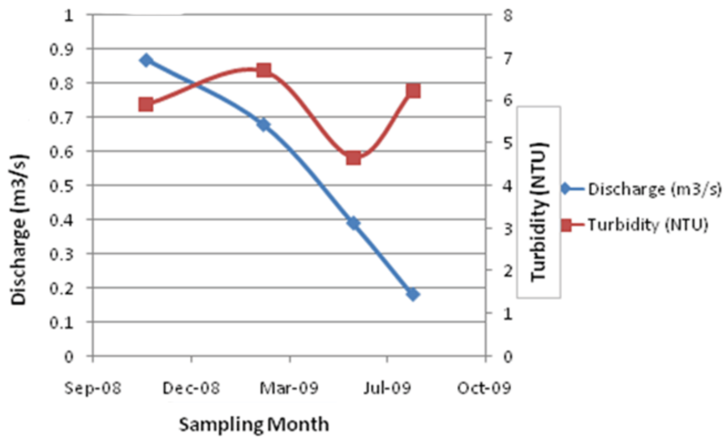

Fig. 3a: Relationship between turbidity and discharge at Sungai Dengar

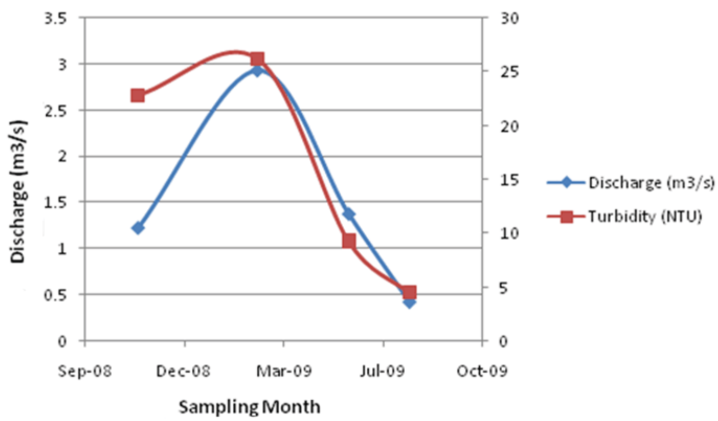

Fig. 3b: Relationship between turbidity and discharge at Sungai Madek

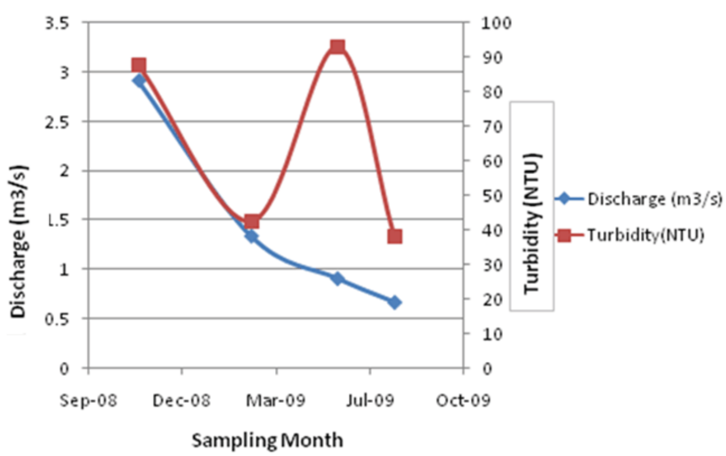

Fig. 3c: Relationship between turbidity and discharge at Sungai Mengkibol

Figure 3a – 3c shows the relationship between turbidity and discharge at Sungai Dengar, Madek and Mengkibol respectively. Figure 3a – 3c have shown a positive relationship between river discharges and turbidity, where turbidity level of the water influenced by river discharges of the rivers.

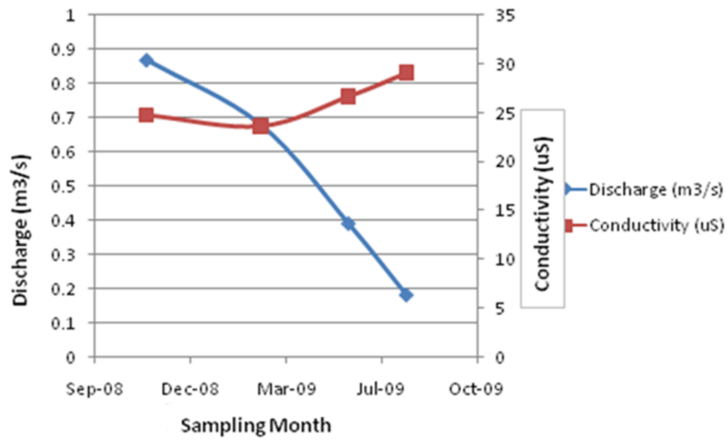

Fig. 4a: Relationship between conductivity and discharge at Sungai Dengar

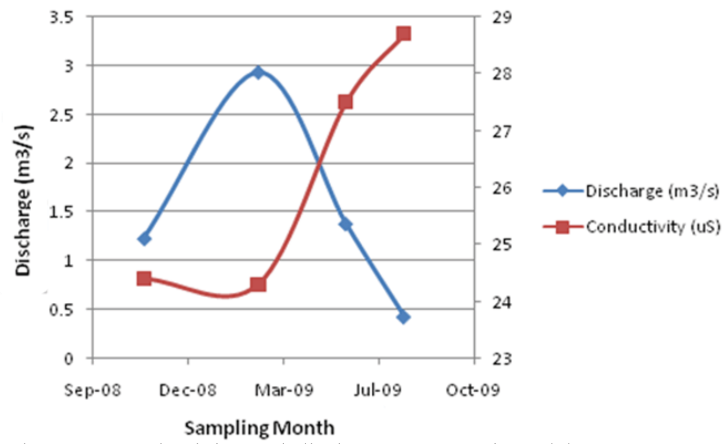

Fig. 4b: Relationship between conductivity and discharge at Sungai Madek

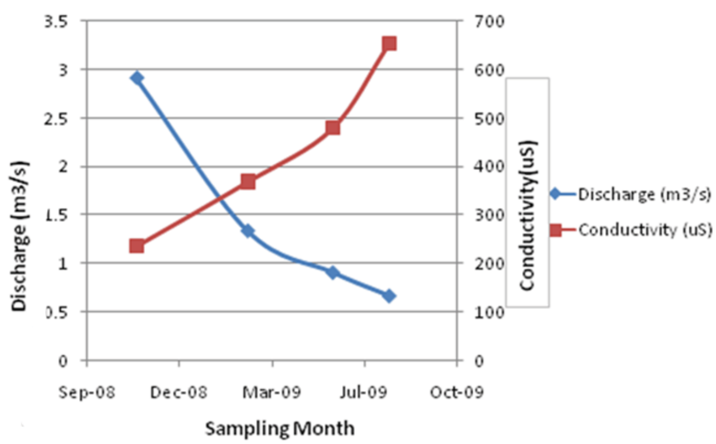

Fig. 4c: Relationship between conductivity and discharge at Sungai Mengkibol

Figure 4a – 4c shows the relationship between conductivity and discharge at Sungai Dengar, Madek and Mengkibol respectively. Figure 4a – 4c have shown a negative relationship between river discharges and conductivity, where high water discharges have a lower conductivity concentrations and vice-versa.

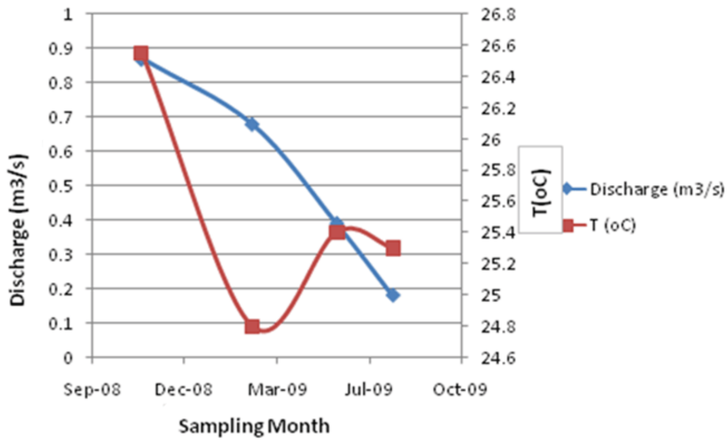

Fig. 5a: Relationship between temperature and discharge at Sungai Dengar

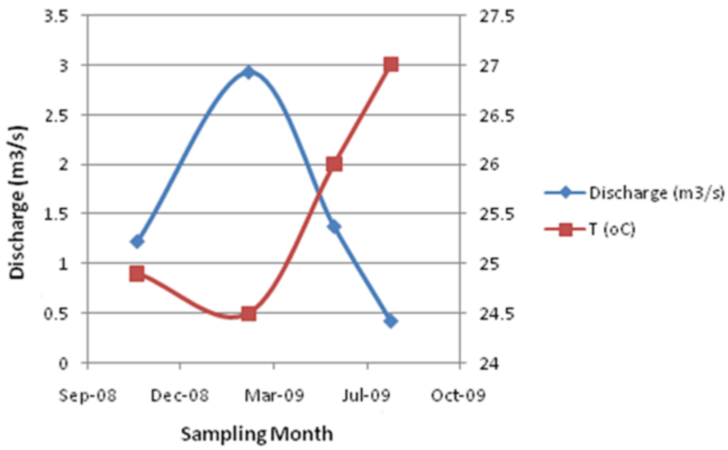

Fig. 5b: Relationship between temperature and discharge at Sungai Madek

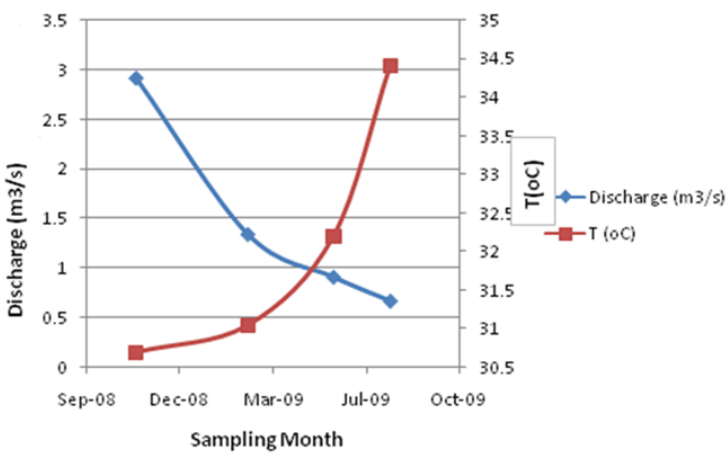

Fig. 5c: Relationship between temperature and discharge at Sungai Mengkibol

Figure 5a – 5c shows the relationship between temperature and discharge at Sungai Dengar, Madek and Mengkibol respectively. Figure 5a – 5c have shown a negative relationship between river discharges and temperature, where high water discharges have a lower temperature concentrations and vice-versa.

Discussion:

The results that was obtained from this study was not confirm to the finding from Kurunc, *et. al.* (2005). Works by Kurunc, *et. al.* (2005) have shown that, there is a positive relationship between temperature, pH, Carbonate and Boron water quality variables with discharge but this study have shown otherwise. There is a negative relationship between pH, dissolved oxygen, conductivity and temperature water quality variables with discharge except turbidity. Here we can suggest that, high water discharge will not influence the concentrations of pH, dissolved oxygen, conductivity and temperature except turbidity. Water becomes more turbid with the increased volume of water or with the increased of water discharge and clearer or less turbid during low water.

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