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Research paper

Analysis of Momentary Variations in the Quality of Water on Specific Criteria in Cole Mere

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ABSTRACT

Momentary changes in some criteria regarding the quality of water were examined by conducting field test and laboratory examination in Cole Mere during the summer months (June, July and August) of 2013. 10 locations were chosen (inside the lake) and each was sampled nearly one month away from the other. The average surface water temperature was documented in June, July and August samplings were 14.1 °C, 21.9 °C and 18.2 °C respectively. The variations in the average temperature were numerically notable (p=<0.001). The average absorption levels of Cholorophyll a were 9.3 μgl^{-1}, 15.2 μgl^{-1} and 39.8 $\mu gl^{-1}$for June, July and August respectively and there was a noticeable difference observed between the months at p=0.001. The detected momentary change and the rising levels of summer chlorophyll a absorption are exact evidence of eutrophic estate. However, no notable variations were observed regarding pH and declined oxygen between the months.

Introduction

With the increase in the population of the world, the demand for water has increased and the quality of ground and surface water keeps on decreasing due to the development of the cities and industrialization. The increase in agricultural activities and a radical change of biogeochemical sequences had serious effects on human input of nutrients on the surface of the planet. In Europe and most other part of the world, afflictions caused by human life has been the primary issue negatively influencing surface water quality leading to eutrophication, acidification, adjoining of toxic elements, material fluctuations and destruction of coastal residence (Heckrath, Rubæk et al. 2007) and as a result eutrophication has been invariably considered as the most significant issue negatively influencing surface water quality which is closely linked to public health interests, economic forces, ecological and aesthetic destruction.

In a natural environment, eutrophication procedure is very slow and happens over thousands of years during which lakes gradually develop and become more fruitful, but anthropogenic activities can have a serious effect on the level at which these nutrients enter lake, and this can provoke disproportionate growth of problematic algae plants and macrophytes (Cloern 2001). Other problems that arise as a result of eutrophication consist of deficiency of oxygen and failure of the water to assist marine life (loss of fundamental breeds), fish kills, deterioration of biodiversity; deficit in water quality for leisure, agricultural, industrial and drinking objectives (McDowell and Hamilton 2013).

Most freshwater habitats together with lakes and meres are biologically responsive to variations in their neighboring circumstances, which as a result affects their water quality. Meres are generally nutrient-rich water habitats that are usually fed mostly by groundwater supply instead of surface water (Usman, Aliko et al. 2015). There are more than 60 Meres and Mosses within the Shropshire-Cheshire plain situated in the North-West Midland of England. The lakes are typically small, lowland with their depth varying from 1 to 31m (Usman, Aliko et al. 2015). They are positioned in bays in the thick mantle created as a result of melting of ice-blocks which are amassed in the area dating back to 14-16000 years in the late Devensian era, and many bays in the region are related to glacial amass compilation. Collectively, they form an array of wetland locations that are important regions of interest (Geneva 2008). Reference (Moss, Barker et al. 2005) accounted that the Meres discovered in the North West Midlands of England exists a total number of lakes of high preserval importance, despite being impacted by high nutrient masses produced from the agricultural activities and population habitations. Despite the correlation of meres with eutrophic criteria for many decades, the great absorbtion and significant change to marine plants have occured over the past 50-100 years.

As the qualities of surface water keeps on disintegrating because of the afflications caused by human life, there have been regulations put in place by the EU since the confirmation of the Directive 76/464/EEC (Discharge of Dangerous Substances Directive) to protect the surface water against contamination. Measures are set out in the Directive to prevent the direct release of lead contaminants and regulating the release restrictions for other pollutions. Years later, Water Framework Directive (2000/60/EC) was introduced with the purpose of preventing disintegration and improving the state of marine ecosystems, and the protection systems in the Directive 76/464/EEC resume into new WFD (Geneva 2008).

However, to reach shared level of ecological quality, the Directive asks individual members to distinguish their different water habitats, depict their current ecological condition, and determine contaminants' origins and to develop an aspired level of quality standard followed by an agenda to reach these goals within a practical schedule. To do this, EU Member States have taken on different supervision methods to help detect the ecological and chemical condition of their rivers, lakes and other water habitats. This supervision is required by the EU Member States in order to create a productive management guidline to reach the goals introduced by Water Framework Directive (2000/60/EC) (Geneva 2008).

Eutrophication control on the other hand, normally allows for supervision of sources of nourishment, important ions and chlorophyll a (Chapman 1996). The need for restricting phosphorus and nitrogen loading to lakes with the purpose of regulating eutrophication has been widely approved (Conley, Paerl et al. 2009). Emphasis has been made primarily on regulating phosphorus input to freshwater lakes as a way of taking hold of eutrophication. Along with attaining the guidelines mentioned above, there is also a requirement to properly examine the momentary change in the water quality criteria. Therefore, the purpose of this paper is accomplished through the following designs: distinguishing the cruicial sampling locations within the lake and its related bays and channels, on-site and off-site supervision of water quality variables (such as declined Oxygen, Temperature and pH) and assessing the chlorophyll a absorptions through uprooting and spectrophotometry method.

I. Materials And Methods

A. Sampling Location

The study was carried on at Cole Mere lake. Cole Mere is a Country Park located 4km to the south east of Ellesmere, 1km to the east of the A528, and 1km south of the A495 with a total area of 54 ha (including the lake).The location is positioned inside the River Severn bay, which is a characteristically moderate aquatic zone, distinguised by cooler winters as along with warmer summers, with average yearly rainfall of 713mm [5]for the area. The lake itself is nearly 27ha with maximum and mean depth of 11.5m and 3.3m (Usman, Aliko et al. 2015) stated in the correct order. The mere seems to have no constant surface inflows independent from small streams and the Shropshire Union Canal. Distinctly, the main source of water that Colemere receives is from under water origin which forms about 61% to 82% [5] of the entire body of water. There is also a manufactured channel to the east of the mere, which discharges water out of the meres, but also acts as a manufactured basin during the times of rise in water levels. The edges of the mere are outlined by plant life (mostly woodlands), and as a totality, the mere aids significant bases of fringe and marine plants, as well as remarkable stages of the unique Least Water-Lily visible to the north side and furnishes a suitable biosphere for marine invertebrate communities. Prior research detail that the lake is eutrophic and high in phosphorus absorbtion naturally which is thought to be discharged from internal loading by sediments, however, the nutrient storing could also be via the water reservoir and by geese as well as other ducks in sight inside the mere (Pothoven and Fahnenstiel 2013).

A total of 10 sampling locations throughout the whole lake were chosen desicively, five from lake shores, three from the lake basins, one from the canal and the remaining one from the lake channel.

B. Sample Gathering

Water sampling was initiated at 10 selected sampling locations allocated along the lake at nearly month break in June, July and August in 2013; the sampling sites consisted of both open lake shore and its related basins and channels. A GPS reading of each sampling location was documented while the first sampling was conducted. On-site estimations of temperature, oxygen in mg/l, percentage concentration were documented using HACH portable case multi-meter at each sampling episode and readings were taking at 5cm depth beneath the water surface. Water samples were also gathered at each sampling site from the near surface of the lake in 1 litre plastic bottles for laboratory examinations.

C. *Sample Examinations*

After every sampling episode, the samples were then transferred to the laboratory for laboratory examinations. pH of newly gathered samples were assessed in the laboratory using *HACH* portable case multimeter before filtration.

For the measurement of chlorophyll *a* absorption, 250 cm^3 of the samples were filtered through. What man GF/C filter with the help of vacuum. The filters were then processed smoothly with the help of forceps and dispatched to glass boiling test tubes pursued by the addition of 14 cm^3 of 96% methanol solution. Uprooting of chlorophyll *a* color was achieved by instilling the bottom of the test tube in a boiling water bath, the methanol was brought to a light boil, and it was left boiling for 30 seconds. The essence was then transmitted to a 14ml tube and centrifuged at about 3000 rpm for 5 minutes. The centrifuged essence ready for spectrophotometric assessment was discharged into cuvettes, the spectrophotometer was set and the device was adjusted or zeroed with a blank of 96% methanol solution in a cuvette at 665nm wavelength. Concentration of the samples was estimated at this wavelength. The gadget was again set to 750nm wavelength and calibrated with a blank 96% methanol solution in a cuvette and the account of the concentration of the samples at this wavelength was also taken.

The chlorophyll a absorption measure was then gathered via the following formula:

$$\text{Chla } \mu g l^{-1} = (abs_{665} - abs_{750}) \times 834$$

D. *Numerical Assessment*

Numerical assessment was finalized through "IBM SPSS Statistics, version 20". Ahead of the assessment, the data was converted into a chart to guarantee that it is regularly allocated. Commonness was analyzed through the test for skew in Excel. The converted data was sent out from Excel to SPSS for Multivariate ANOVA analysis (MANOVA). However, momentary currents were examined more thoroughly by setting post hoc (Bonferroni) test to compare the mean differences between the months.; the results are presented in the result chapter (see Table 1) by the use of similar subcategories (*a*, *b* and *c*).

II. Results And Discussion

Temperature is a significant physical factor employed in estimating water quality and decrease or increase in temperature which may negatively influence other water quality factors. For instance, it has been recorded that disintegrated quality of oxygen to dissolve decreases with increase in temperature. The momentary fluctuations in temperature during the time of the research (June, July and August) are documented. The average temperature (14.1 ℃) was documented in June which rose to a great degree to 21.9 ℃during the July sampling, and somewhat drops to 18.2 ℃in August (Fig. 1). The momentary patterns in temperature were examined numerically and the result (see Table I) exhibited a striking difference between the months ($p = < 0.001$). July is typically regarded with high temperature, June was the lowest and August falls in between.

Declined oxygen (D.O.) is yet another significant water quality factor which can easily be impacted by temperature as mentioned earlier. It is a significant mark of the entire marine ecosystem health as it regulates the organism's metabolism, and normally recommended that if D.O. level in marine system can foster fish, it is likely to benefit from the good ecological quality for other applications. Throughout the research, in all the locations dissolved oxygen fluctuates between 4.6mg/l to 12.8mg/l. in all the lake sampling locations, D.O. was higher in July than it was in June and August, despite the fact that July water temperature is higher than June and August. The rise of D. O in July could likely be related to disproportionate photosynthetic activities of planktons and algae in the surface water (Dar, Mir et al. 2013). The lower figures recorded from the canal and bay samples in July and August result from their contrast in water chemistry and may be caused by some contaminants.

pH as significant physical factor can be influenced by many determinants such as pollution, photosynthesis and freshwaters input (Hosmani and Mruthunjaya 2013). The average pH figures recorded in this research are 8.27 and 8.37 for July and August in the exact order, and it was low (7.96) in June. pH accumulation from both origins and the average of each study month align with the perfect demand for all river types in England (Calder, Harrison et al. 2008) and the suggested 6.5-9.5 (Usman, Aliko et al. 2015) based on aesthetic estate.

Chlorophyll *a* in company with other variables has been regarded as a significant water quality indication. Within this research, momentary fluctuations in chlorophyll *a* absorption have been documented during the time of the study. Average absorptions in summer differed notably between the months (June 9.37µgl⁻,¹ July 15.20 µgl⁻ ¹and August 39.81 µgl⁻)¹. The average variations were numerically noteworthy (see Table I) where p=0.001. The general summer mean chlorophyll *a* absorption (38.1µgl⁻ ¹) estimated throughout the study has much proximity with (42.8 µgl⁻)¹ [4] winter and growth season average in Cole Mere. As opposed to this summer findings which were much higher when equated with those of (Jones, Solomon et al. 2012), they recorded the mean water column chlorophyll *a* in south-eastern Lake Michigan, their mean summer values fluctuated between 1.02 µgl⁻ ¹and 2.22 µgl⁻ ¹from 1995 to 2000, and 0.70 µgl⁻ ¹and 1.05 µgl⁻ ¹from 2007 to 2011; their result exhibited that the lake is oligotrophic while this summer results depicted a eutrophic estate. Reference (Moss 2008) in a review of three Meres, accounted that summer average chlorophyll in Little Mere was 40 µgl⁻,¹Mere Mere 42 µgl⁻ ¹(1994-200) and Rotherne Mere 21.2-66 µgl⁻,¹; these higher values prove the conviction that the mere are characteristically eutrophic.

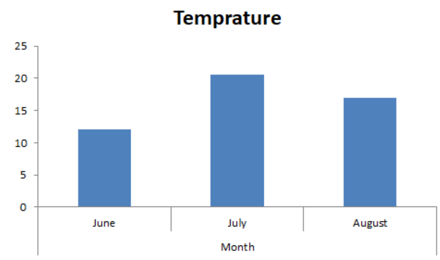

Fig. 1. Temporal variability in temperature (°C) over the study months.

High Chlorophyll a absorption was documented at all locations throughout this research, this is an intelligible evidence that the mere water quality is disintegrating at a fast rate as the absorption surpasses oligotrophic level at all loctions and the absorption increases momentarily developing hypereutrophic estate in August (Fig. 2). While summer figures are predicted to be high as a result of the rising temperature, and probably phosphorus discharged from sedimentation of sand many other parameters, the figures are still startling; therefore, indicating the requirement for more examination , supervision, and likely some rehabilitation efforts.

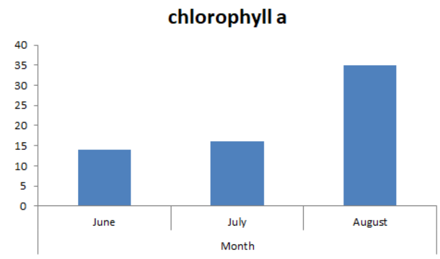

Fig. 2. Momentary change in chlorophyll a absorption during the time of the research.

Table I: The Numerical Contrast Between The Months Of The Research Via One-Way Manove (Bonferroni, Post Hoc Test)

Variables	Months	Mean	SE	F	P
Temperature	June	13.89	0.018	24.65	0.00
	July	20.92			
	August	17.87			
Oxygen	June	10.04	0.031	1.29	0.274
	July	8.96			
	August	8.21			
pH	June	7.96	0.019	1.477	0.249
	July	8.37			
	August	8.27			
Chlorophyll a	June	9.37 a	0.107	8.973	0.01
	July	15.20 a			
	August	39.81 b			

Midpoints with the same letter (*a*, *b* or *c*) are not substantially different from each other.

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