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WATER QUALITY ANALYSIS OF COLEROON RIVER WITH SPECIAL REFERENCE TO DISSOLVED OXYGEN, AMMONIA, NITRITE, BOD AND COD

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ABSTRACT

Water is one of the principal components in determining the quality of the human live .This work is intended to determine the overall water quality of the river. River are the most fertile, diverse, productive and interactive ecosystem in the world. For the present research work four sampling sites were identified and river water quality was analysed on a monthly basis over a period of 13 months. Every water sample was analysed for temperature, pH, salinity, conductivity, total dissolved solids, total alkalinity, hardness, turbidity, dissolved oxygen, chloride, nitrate, phosphate, ammonia, biological oxygen demand and chemical oxygen demand. The study revealed that the river water was alkaline. The results indicated that water quality parameters of the Coleroon river water were within the permissible limits and can be used for domestic, irrigation and pisciculture.

INTRODUCTION

Water is one of the most important and abundant compounds of the ecosystem. All living organisms on the earth need water for their survival and growth. As of now only earth is the planet having about 70 % of water. But due to increased human population, industrialization, use of fertilizers in the agriculture and man-made activity it is highly polluted with different harmful contaminants [1]. River are one of the most productive ecosystems, comparable to tropical evergreen forests in the biosphere and play a significant role in the ecological sustainability of a region.

The availability of good quality water is an indispensable feature for preventing diseases and improving quality of life. Natural water contains different types of impurities are introduced in to aquatic system by different ways such as weathering of rocks and leaching of soils, dissolution of aerosol particles from the atmosphere and from several human activities, including mining, processing and the use of metal based materials [2]. Rivers remove nutrients (especially nitrogen and phosphorus) particulates and total biological oxygen demand from flooding waters for plant growth and it helps prevent eutrophication or over-enrichment of other forms of natural waters. However, overloading of nutrients beyond its threshold impairs its ability to perform basic functions.

Human influence on these water bodies causal by rapid cutting of surrounding vegetation thus increasing silt and nutrient load, disposal of the sewage and industrial waste, use for open defecation cultural activity agriculture around the water bodies using agrochemical greatly increase the quantity of nutrients and organic matter input to a water body. Thus the river starts getting eutrophical at a very early stage. Several studies have been conducted so far to understand the physic-chemical properties of rivers, ponds and reservoirs in India [3-11]. So far, there is no study on this river. Coleroon River is main source of agricultural irrigation and fishing purpose. The present work was undertaken to analyze the quality of water.

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MATERIALS AND METHODS

Study Area

The river Coleroon is the drainage carrier of Cauvery, branching out near Upper Anaicut. Normally, the entire floodwaters of Cauvery, surplus from Mettur dam are being diverted to Upper Anaicut and Coleroon directly and also through Grand anaicut. The total length of river Coleroon is 160 miles from Upper Anaicut and it flows through the districts of Trichy, Perambalur, Ariyalur, Thanjavur, Cuddalore, and Nagapattinam, finally, falls into the Bay of Bengal. Coleroon River (Coleroon River) is a distributary (-ies) (class H - Hydrographic) in India (general), India (Asia) with the region font code of Asia/Pacific. It is located at an elevation of 1 meters above sea level. Coleroon River is also known as Coleroon River, Kolladam, Kollidam. Its coordinates are 11°22'60" N and 79°46'0" E in DMS (Degrees Minutes Seconds) or 11.3833 and 79.7667 (in decimal degrees). Its UTM position is LT65 and its Joint Operation Graphics reference is NC44-02. Almost 70% of the districts economy is dependent on agricultural and horticulture activities. People are engaged in the cultivation of paddy, millets, pulses, and sugarcane.

Sample Collection:

The water samples were collected from four different sites (S1, S2, S3 and S4). The water samples were collected from surface zone from the depth of 0.3m on the second week of each month from June 2013 to June 2014. The collection of water samples was done during morning hours (5am to 8 am) on a fixed date in acid washed 1.5 litre capacity plastic bottles with necessary precautions [12]. Physico-chemical analysis of water was carried out referring the standards methods. Various methods used are listed in (table -1). The temperature, pH and dissolved oxygen were determined in the field. The collected samples were brought to laboratory and analyzed within 24 hours, except the biological oxygen demand, which require a period of five days for incubation at a temperature of 20^{o}C using standard methods [13]. All the analysis was repeated five times. The range of water quality is presented. Analysis of variance was conducted using MINITAB software to determine the significance in the difference in distribution of factors among the different stations selected. The mathematical relationship of transparency of water with other physical characteristics were assessed in linear and non linear models using the CURVEXPERT software and the significantly correlated best suitable models were determined based on coefficient of determination (R2) and standard error values (SE) and the equations are presented.

All the analysis was repeated five times. The range of water quality is presented. Analysis of variance was conducted using MINITAB software to determine the significance in the difference in distribution of factors among the different stations selected.

The mathematical relationship of transparency of water with other physical characteristics were assessed in linear and non linear models using the CURVEXPERT software and the significantly correlated best suitable models were determined based on coefficient of determination (R2) and standard error values (SE) and the equations are presented.

Table 1. Physico-chemical analysis by different method

Parameter	Method / Equipment Used
Temperature	Digital Thermometer
pH	Digital pH meter
Alkanity, DO, BOD, COD	Titrimetry method
Phophate, Nitrate	UV Visible spectro-photometry

Table 2. The detailed observations for the fluctuation in all the physic chemical parameters (DO, Ammonia, Nitrate, BOD & COD) are recorded

Station	I	II	III	IV
Dissolved Oxygen				
June'13	6.1	6.1	8.1	8.1
July'13	6.16	6.46	6.06	7.52
Aug'13	8.52	9.78	7	10
Sep'13	9.04	6.56	9.24	9.14
Oct'13	8.52	8.8	8.75	9.18
Nov'13	9.29	9.29	8.08	10.2
Dec'13	10.2	10.12	7.1	10.1
Jan'14	6.86	8.15	10.1	8.17
Feb'14	6.06	6.56	10.1	8.08
Mar'14	6.06	6.06	7.2	7.28
Apr'14	6.86	6.46	6.06	8.17
May'14	8.21	6.06	7.28	7.28
Jun'14	6.56	6.06	6.86	6.98

Station	I	II	III	IV
Ammonia				
June'13	0.01	0.18	0.12	0.12
July'13	0.12	0.19	0.024	0.192
Aug'13	0.12	0.19	0.14	0.072
Sep'13	0.52	0.55	0.6	0.48
Oct'13	0.24	0.14	0.24	0.12
Nov'13	0.43	0.16	0.96	0.12
Dec'13	0.45	0.19	0.192	0.12
Jan'14	0.48	0.21	0.192	0.36
Feb'14	0.26	0.48	0.38	0.16
Mar'14	0.4	0.37	0.48	0.23
Apr'14	0.49	0.06	1.25	0.02
May'14	1.09	1.4	072	0.19
Jun'14	0.15	0.6	0.85	0.17

Station	I	II	III	IV
BOD				
June'13	20.4	12.14	26.14	20.21
July'13	21.32	10.46	27.96	20.98
Aug'13	17.46	19.34	22.96	24.74
Sep'13	16.16	21.38	20.2	40.54
Oct'13	16.16	27.96	16.32	40.81
Nov'13	21.04	21.04	14.56	44.62
Dec'13	22.96	35.56	12.96	56.12
Jan'14	22.28	14.56	24.52	50.85
Feb'14	19.72	11.66	22.56	44.65
Mar'14	19.32	11.66	22.56	44.65
Apr'14	21.4	11.46	28.08	56.98
May'14	15.92	16.44	12.92	28.84
Jun'14	26.48	27.26	12.92	12.54

Station	I	II	III	IV
Nitrate				
June'13	0.03	1.4	3.1	0.13
July'13	0.5	1.2	3.47	0.1
Aug'13	0.6	0.7	2.3	0.11
Sep'13	0.6	0.3	0.5	0.13
Oct'13	0.6	0.4	0.6	0.3
Nov'13	0.65	0.7	0.7	0.5
Dec'13	0.7	0.5	1.3	0.6
Jan'14	1.2	0.4	0.76	0.8
Feb'14	2.5	0.3	0.56	1.8
Mar'14	1.37	0.4	0.6	2.08
Apr'14	1.43	0.7	2.3	2.68
May'14	1.74	1.43	1.19	2.97
Jun'14	1.47	2.01	1.2	2.68

Station	I	II	III	IV
COD				
June'13	24	62	88	60
July'13	30	52	77	35
Aug'13	24	48	64	84
Sep'13	26	28	32	60
Oct'13	20	28	36	60
Nov'13	44	36	32	62
Dec'13	76	40	52	20.25
Jan'14	76	20	28	72
Feb'14	44	32	60	58
Mar'14	56	28	64	48
Apr'14	32	40	41	35
May'14	40	48	60	43
Jun'14	38	46	48	58

The monthly variations in various physic-chemical parameters of the Coleroon river at the selected sites shown in Fig. 2 to Fig. 6.

Figure 1. Map showing study area

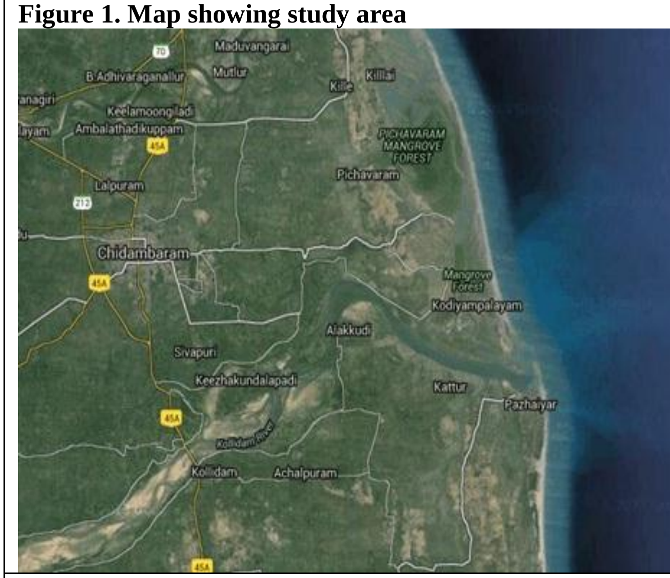


Figure 2. Seasonal variation of dissolved oxygen (mg/L) in four stations during June 2013to June 2014

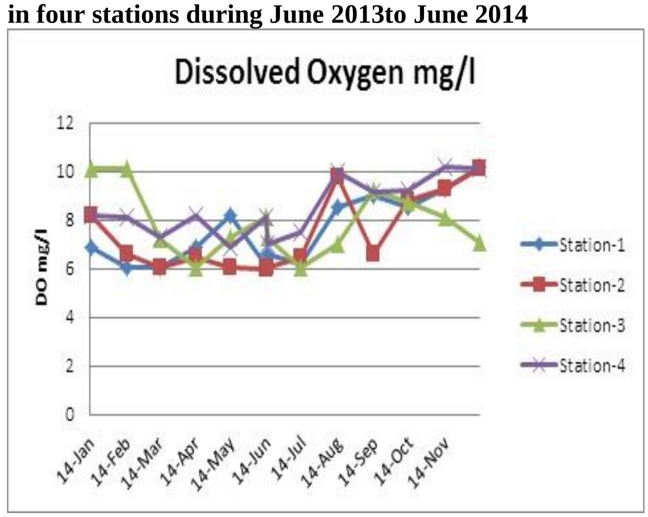


Figure 3. Seasonal variation of Ammonia (mg/L) in four stations during June 2013to June 2014

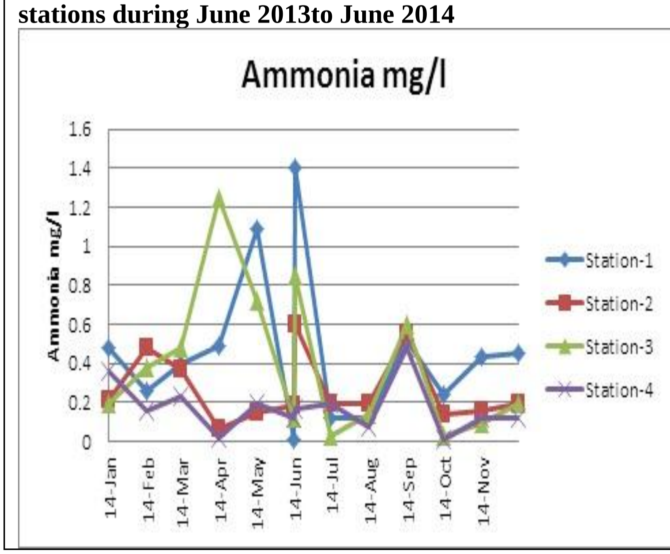


Figure 4. Seasonal variation of Nitrite (mg/L) in four stations during June 2013to June 2014

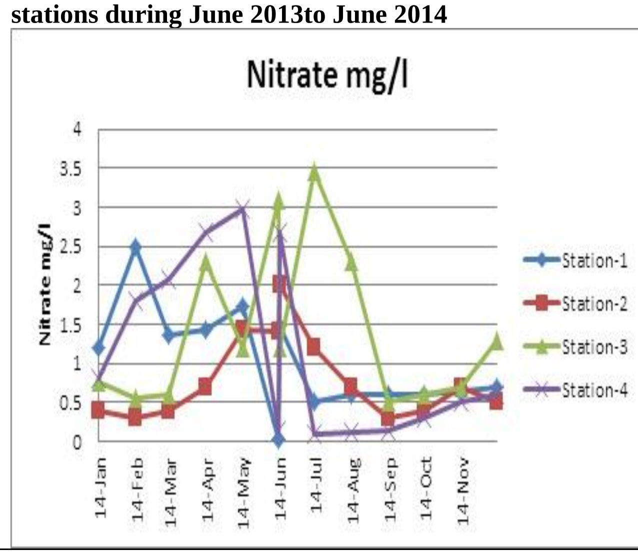


Figure 5. Seasonal variation of BOD (mg/L) in four stations during June 2013to June 2014.

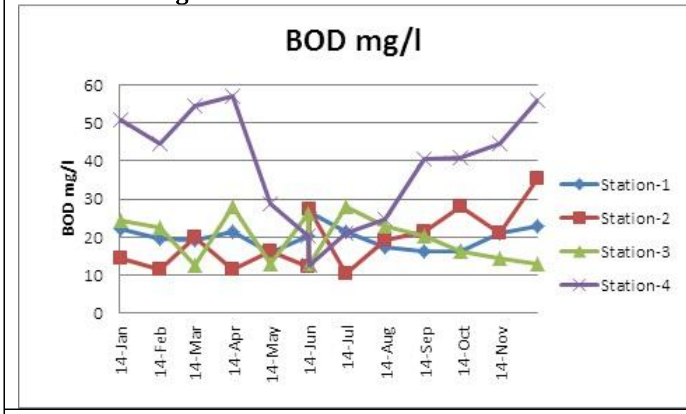


Figure 6. Seasonal variations of COD (mg/L) in four stations during June 2013to June 2014

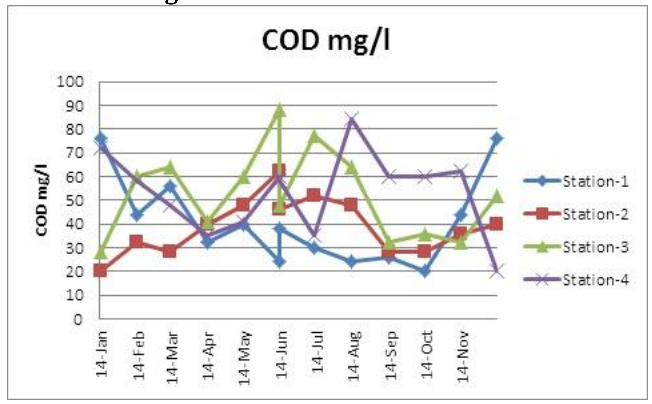


Figure 7. Polynomial fit showing the mathematical Relationship between DO and ammonia

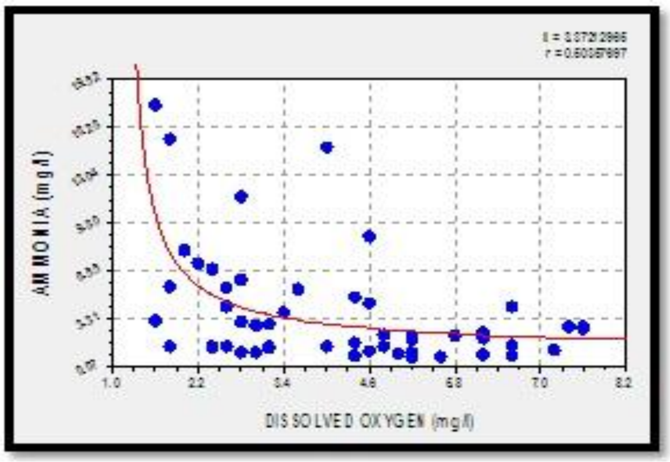


Figure 8. Polynomial fit showing the mathematical Relationship between DO and nitrate

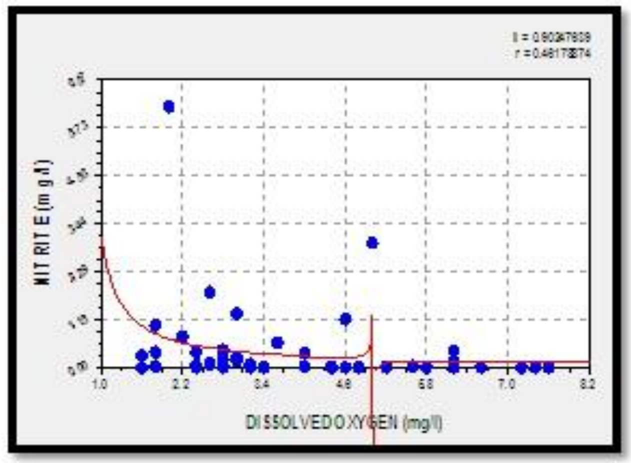


Figure 9. Polynomial fit showing the mathematical Relationship between DO and BOD

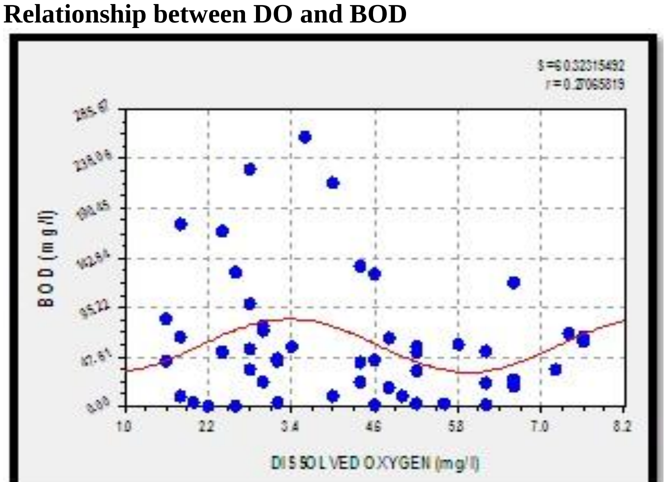
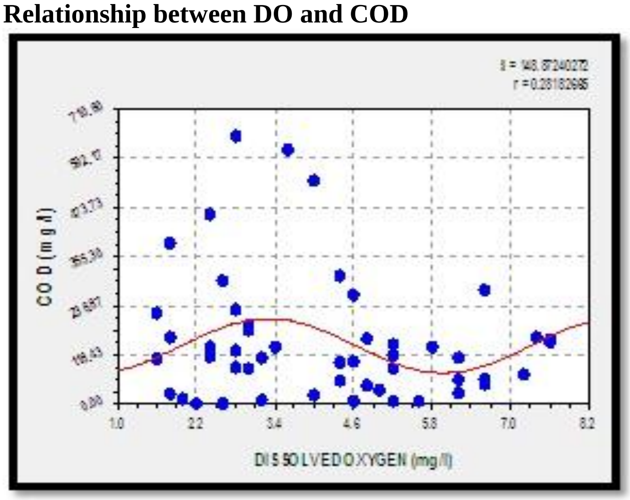


Figure 10. Polynomial fit showing the mathematical Relationship between DO and COD



RESULTS AND DISCUSSION

The results obtained by physic-chemical analysis of all samples are given in above tables. Marked differences in various parameters were observed due to the climatic conditions and pressure of anthropogenic activities.

Dissolved oxygen in water is great importance to all aquatic organisms and is considered to be the factor which reflects physical and biological process taking place in a water body. It is important in the production and support of life.

It determines the nature of an entire aquatic ecosystem to a great extent. Water body receives the supplies of oxygen mainly from two sources directly from atmosphere and during the process of photosynthetic activity of chlorophyll bearing plants. Concentration of dissolved oxygen also depends on surface agitation due to temperature, respiration rate of the living organisms and decomposition rate of dead organic matters. In the present investigation, the low content of dissolved oxygen at Station-II (6.0 mg/L) in June 2013 may be related to microbial activity. This is in agreement with the findings of Zutshi and Abhas and Singh [14]. The maximum amount of dissolved oxygen was (10.2 mg/L) recorded at Stations-I in December 2013 when there was plenty of aquatic vegetation covering the river surface. Ravichandran & Rakesh Sharma from river Cauvery in Trichy confirms the above results.

Biochemical Oxygen demand determines the amount of oxygen required by bacteria in stabilizing the decomposable organic matter. The biodegradation of organic materials exerts oxygen demand. BOD gives an idea about the extent of pollution. BOD has been a fair measure of cleanliness of any water on the basis that values less than 1-2 mg/l are considered clean, 3 mg/l fairly clean, 5 mg/l doubtful and 10mg/l definitely. BOD was found to be exceeding the permissible limits in all the stations. The high BOD value (56.98 mg/L) was noted at station IV in April 2014 and the low content of BOD at Station-II (11.46 mg/L) in April 2014 in the river which may be due to absorption of pollutants by aquatic flora in river system. It may be due to the over loaded input of organic matter by human activities like dumping industrial waste, domestic waste, sewage disposal and use of soap and detergents for washing cloths and bathing, etc., Subramani [15] and Ravichandran and Rakesh Sharma from river Cauvery confirms the above results.

Chemical Oxygen demand determines the amount of oxygen required for chemical oxidation of most organic matter and oxidizable inorganic substances with the help of strong chemical oxidant. The untreated discharge of municipal and domestic waste in water bodies increases the amount of organic content and organic load due to allochthonous and autochthonous sources. Kalavathy [16] and Ravichandran & Rakesh Sharma from river Cauvery in Trichy confirms the above results. Chemical oxygen demand (COD) was much higher (98.2 mg/l) and dissolved oxygen and COD maximum permissible limit for DO as per WHO is 4.6-6.0 mg/l. In the present investigation the value of Chemical Oxygen Demand (COD) value ranged from 20 mg/L to 88 mg/L. The highest values were noted in the month of July 2013 at station-III and lowest values were noted in the month of October 2013 at stations- I and January 2014 station II.

Nitrite

Nitrite was recorded more or less similar in all the stations and seasons (Figure 5). Nitrite contents high (3.47mg/L) were noted in the month of July 2013 at station-III and low nitrite contents (0.03mg/L) were noted in the month of June 2013 at Station I. The peak values of nitrite observe during the monsoon may be attributes to the influence of seasonal rainfall. The higher concentration of nitrite and seasonal variation may also be attributes to the variation in phytoplankton excretion and oxidation of ammonia [17]. Low values of nitrite observed during the summer may be due to the lesser amount of freshwater inflow and higher salinity. Similarly maximum value in monsoon and minimum value in summer season was also recorded by Moscow and Kalavathy from Cauvery river, Trichy [18].

AMMONIA (NH_3) presence of ammonia in water is water dangerous pollution. In the study area the concentration of Ammonia is ranged from 0.01 to 1.4 mg/L. The lowest value 0.01 mg/L is measured in June 2013 at stations-I and II whereas the highest value 1.4 mg/L is funded in June 2014 at station-IV. According to WHO the allowable amount of free ammonia in water 0.3 mg/L. According to we can summarize that the waters of Coleroon River is agreeable limits. The dissolved oxygen was found to have significant correlation with BOD (r= 0.7062) COD (r= 0.6093) ammonia(r= 0.5035) and nitrate (r= 0.9017) among the different parameter recorded. Among these parameter BOD (fig-7) COD (fig-8) ammonia (fig-9) nitrate (fig-10) showed polynomial fit and the relationship can be expressed.

CONCLUSION

The results clearly suggest that the DO can be a suitable and easy index to predict BOD, COD, nitrate as well as ammonia of water. Investigations of these nonlinear derivations should be made in different types of ecosystem with different characteristics for deriving a universal nonlinear equation for predicting such parameters.

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CONFLICT OF INTEREST:
The authors declare that they have no conflict of interest.

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