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Research Paper | Biotechnology

Application of One Way ANOVA and Tukey's HSD Post Hoc test to Ecological Data

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ABSTRACT

One Way Anova and Tukey's HSD test was applied to the ecological data. The hypothesis was wheather there is any significant impact of four parameters(Dissolved oxygen, Carbondioxide, Total phosporous and Nitrates) on the Desmid population of a lake at Mysore district. The output data from an online calculator indicated that Carbondiocide and Dissolved oxygen were the most significant parameters operating in the lake. Desmids were at their optimum during the month of August. The tests serve as a handy tool in the interpretation of large ecological data.

KEYWORDS: Anova, Tukey's Desmids, Carbondioxide, Dissolved oxygen.

Introduction

Ecologists often experience difficulty in interpreting ecological data mainly because of the vast and varied data collected.The use of analysis by Anova for a particular set of data is useful and precise in interpreting and determining the hypothesis(null hypothesis). On one hand the null hypothesis determines wheather the data is signifinat or not, but if it is significant it does not indicate which of the means are significantly different.

Tukey's method also known as Tukey's Honestly Significant Difference(HSD) is commonly used to determine the difference between the means of any two groups before they can be considered significantly different. Tukey's method is considered to be robust in that it does not under estimate the least significant difference(less likely to reject the null hypothesis). This confirms that if the difference between the means of the two groups is greater than the least significant difference, then the two groups can be considered different.An important assumption of the Tukey's method is that all the groups are of similar size.

The ANOVA and Tukey's test were applied to the ecological data where in a group of four important chemical parameters were related to Desmid population, in a lake at Mysore district. Stress is laid upon the application of the test rather than the data. An online calculator was used for this purpose.

Materials and Methods

During an extensive study on plankton ecology in Bannur Lake of Mysore, data on chemical and plankton(desmids) counts were made. The data used in the present study represents a part of the ecological study. Four parameters, Dissolved Oxygen, Carbon dioxide, Total Phosphorous and Nitrates were chosen and their relation to desmids was studied. Chemical paramaters were analysed using the methods described in APHA, (1995). The desmids were identified referring to Scott and Prescott(1961) and counts were made by the Lackey's drop method(1938) modified by Suxena (1987). The study period was from June 2011 to May 2012.

The data was subjected to the Anova and Tukey's test using an online calculator for independent samples(http://vassarstats.net/anova La.html). The tukey's test will automatically be performed if there is significant difference between means. Significant difference between means(HSD=the absolute(unasigned) difference between any to samples means required for significance at the designated level(0.05 or 0.01)

Results and discussion

The results of the data are presented in Table and the data output is represented in Table 2. The desmid counts were not incorporated into the calculator because of the difference in units of measurements of the chemical factors(mg/L) and the desmid counts(o/L). One probable question that may be asked is; Why only these four chemical parameters? In order to arrive at the importance of these four parameters, a fuzzy logic was used. Experts in plankton ecology, researchers, scientists, phycologists and environmental analysts were asked to rank chemical parameters related to desmids from a list of 14 provided. The number of respondents were about 500 . Eight top rated parameters were again sent to the same respondents and were asked to rank only 4 top parameters These four parameters were Dissolved oxygen, Carbondioxide, Total phosphorous and Nitrates that had an impact on desmid popultion. Desmids are highly sensitive to the slighest change in water quality. The lake water under consideration is fed by river water and hence the water quality fluctuates regularily when influx of freshwater occurs.

The out put data of the test is presented in Anova Summary. The combination of Dissolved oxygen with Nitrate and Total phosphorous is not significant. Similarily the relation between only Nitrates and Total phosphorous is also not significant. The coordinated activity of the two gases namely, Dissolved oxygen and Carbon dioxide have a significant effect. Carbon dioxide in turn can have an impact on the Nitrate and Total phosphorous . The predominat and most significant chemical parameters in the lake are Dissolved oxygen and Carbondioxide (Fig. 2). The most common desmids in the lake during the course of the study are shown in Fig. 1 .The dominance was seen during the months August (Fig.3). Carbon dioxide was extreemely high followed by Dissolved oxygen while the other two parameters were less significant.

Conclusion

Analysis of ecological data using the Anova and the Tukey's Post Hoc HSD test provides precise conclusiosn in analysis of ecological data. From the out put it is clear that in the present study Dissolved oxygen and Carbondioxide are the two main parameters controlling the growth of desmids.Total phosphorous and Nitrates are less significant. Desmids dominate the lake during the month of August. Carbondioxide is the most prominant chemical parameter in Bannur Lake. The online free Anova calculator for independent samples is a handy tool and can be used to interpret ecological data useful in lake conservation studies.

Table 1: Chemical features and desmid population of Bannur Lake (2011-2012)

Months	DO	NO3	TP	CO2	Desmids
June	6.9	0.01	0.17	32	308
July	8.5	0.01	0.19	18	400
August	13	0.00	0.14	00	5600
September	9.3	0.01	0.16	50	480
October	7.3	0.04	0.18	66	1920
November	9.8	0.01	0.10	06	480
December	11	0.05	0.20	40	960
January	9.2	0.03	0.20	38	1920

February	9.5	0.01	0.16	19	1440
March	9.3	0.03	0.14	66	480
April	7.3	0.01	0.18	18	440
May	9.7	0.01	0.20	52	480

DO-Dissolved Oxygen; NO3-Nitrate, TP-Total phosphorous, CO2-Carbondioxide (mg/l) Desmids expressed as organisms/L

Table: 2. Data output of An ova and the Tukey's HSD Test

SAMPLES				
	DO	NO3	TP	CO2
N	12	12	12	12
∑X	110.8	0.22	2.02	408
Mean	9.23	0.018	0.16	34
∑X2	1054.	0.007	0.35	19074
Variance	2.853	0.002	0.09	472.9
Std. Dev.	1.689	0.015	0.03	21.74
Std. Error	0.487	0.004	0.01	6.277

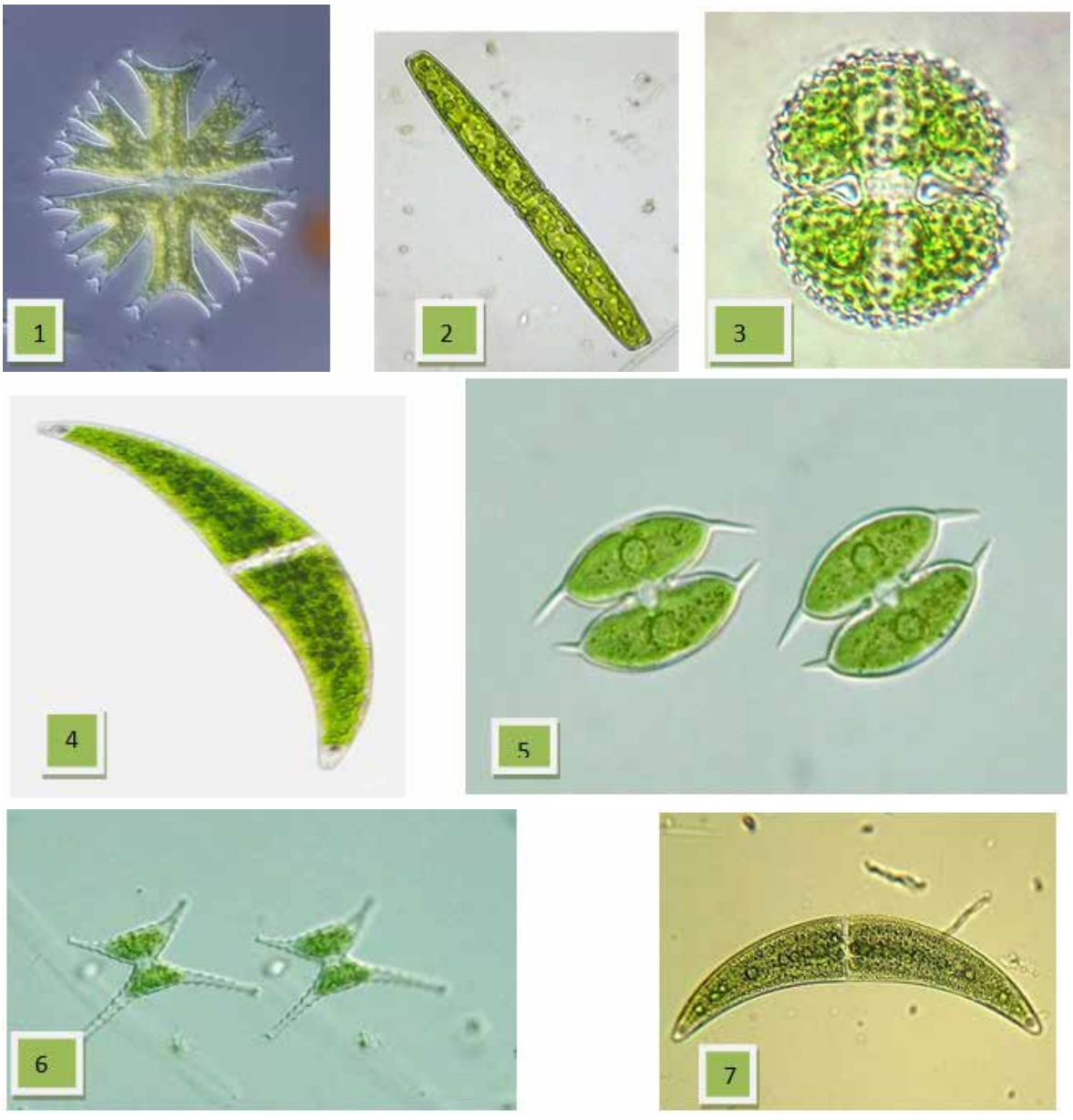
ANOVA SUMMARY: Independent samples k=4
The Tukey's HSD is the absolute (unsigned) difference between any two sample means required for significance at the designated level.HSD (0.05=11.93; HSD (0.01)=14.71.

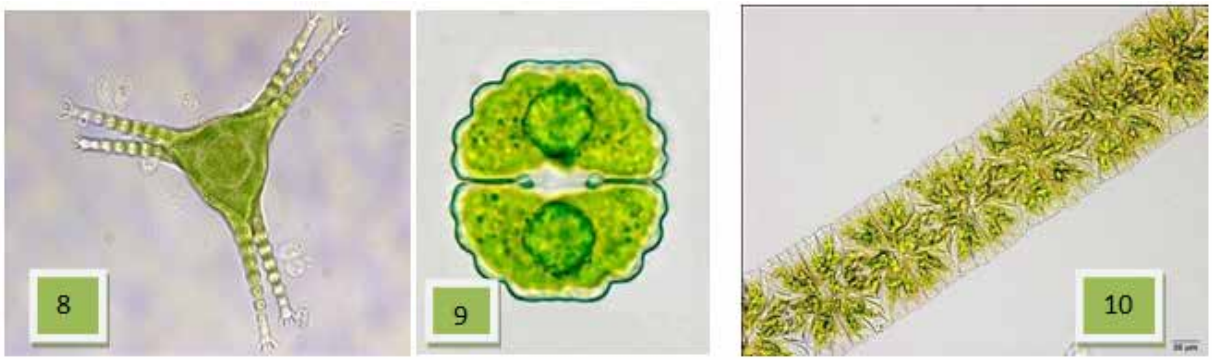
(M1 vs. M2: DO vs. NO3: not significant
(M1 vs. M3) DO vs. TP: not significant

(M1 vs. M4): DO vs.CO2: significant (P<0.01)
(M2 vs. M3)NO3 vs. TP: not significant

(M2 vs. M4) NO3 vs. CO2: significant ((P<0.01)
M3 vs. M4) TP vs. CO2: significant (P<0.01)
M1 to M4 are means of the sample values analysed for the entire year)

Fig. 1:Common Desmids occurring in Bannur Lake (2011-2012)





1. Micrasterias radiata, 2.Pleurotaenium trabecula, 3. Cosmarium reniforme, 4.Closterium ehrenbergii, 5. Arthrodesmus convergens, 6. Staurastrum creatus, 7. Closterium moniliforne, 8. Staurastrum tetracerum, 9. Cosmarium subprototumidium, 10. Micrasterias foliaceum

Fig. 2. Chemical features of Bannur Lake: 2011-2012

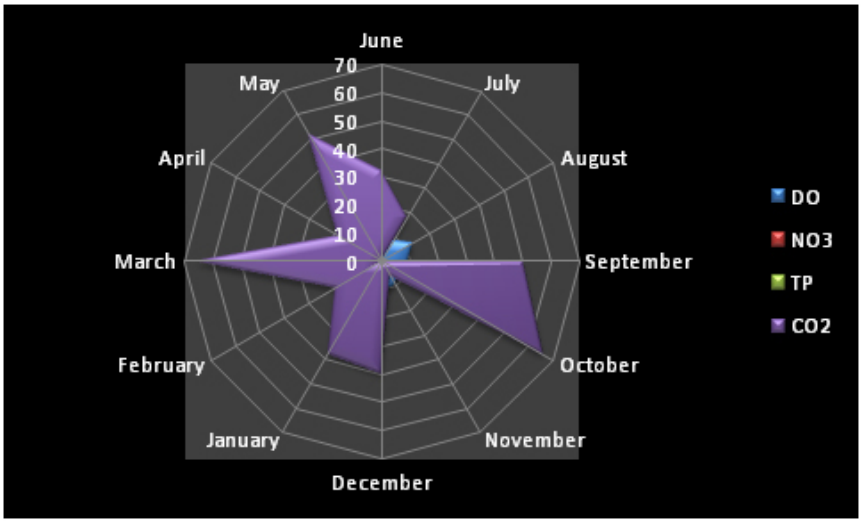
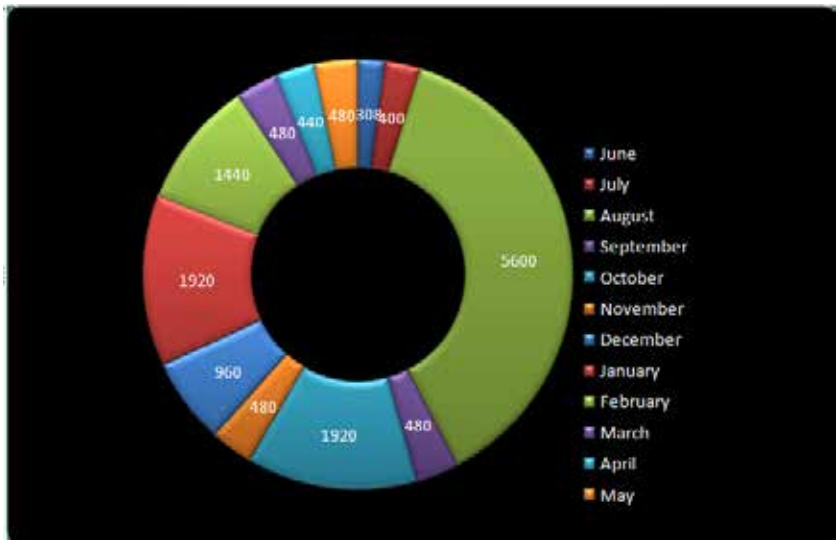


Fig. 3. Desmids of Bannur lake: 2011 -2012.



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