

# A REGRESSION MODEL FOR THE PREDICTION OF PLANKTONIC FORMS WITH EXOSKELETON

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A multiple regression model for the prediction of biomass of planktonic forms with exoskeleton was developed using International Indian Ocean Expedition (IIOE) data based on displacement volume of plankton collected from meridian 110° E. In the regression model biomass was correlated with temperature, salinity, phosphate-phosphorus, nitrate-nitrogen and oxygen. The fitted multiple regression model was found to be highly significant ( $p < 0.001$ ) and explained nearly 40% of the variability in biomass. Among the variables included in the model, relative importance of salinity was found to be the maximum followed by nitrate-nitrogen, temperature, phosphate-phosphorus and oxygen, in predicting biomass of planktonic forms with exoskeleton.

## INTRODUCTION

Statistical analysis of the International Indian Ocean Expedition (IIOE) data are rare when compared to the volume of data processed. This was mainly due to the fact that most of the data collected during IIOE could not be put to rigorous statistical analysis. However, the systematic collections made at stations in meridian 110° E provided substantial data for a reasonably sound statistical analysis. Tranter (1973) has made correlation analysis of the data collected from stations in meridian 110° E. In the present study statistical analysis leading to development of a multiple regression model for the prediction of biomass of planktonic forms with exoskeleton is attempted.

## MATERIAL AND METHODS

Displacement volume of planktonic organisms with exoskeleton (Crustacea and Mollusca excluding Heteropoda other than Atlantidae) contained in 68 standard samples taken during IIOE at stations in meridian 110° E was utilised for the present study. For the regression model, the correlation between the displacement volume of forms with exoskeleton with each of the variables, temperature, salinity, phosphate-phosphorus, nitrate-nitrogen and oxygen were calculated. For calculating the coefficient of correlation, the maximum values reported in the I. O. B. C. handbook (1971) were used. All the correlation coefficients being found significant, the level of significance varied between 5% and 0.1%, it was decided to connect the displacement volume with the variables reported above by a multiple regression model,

$$Y = b_0 + b_1 X_1 + b_2 X_2 + b_3 X_3 + b_4 X_4 + b_5 X_5,$$

where  $Y$  = displacement volume,  $X_1$  = temperature,  $X_2$  = salinity,  $X_3$  = phosphate-phosphorus,  $X_4$  = nitrate-nitrogen and  $X_5$  = oxygen. The multiple regression model was fitted to the data by the method of least squares and the normal equations were solved with the help of a desk calculating machine. The significance of the fitted regression was tested using analysis of variance technique and the results are presented in Table 1. Also the relative importance of each of the variables mentioned in the prediction equation was calculated using the formula

$b_{ix} \sqrt{\sum x_i^2 / \sum y^2}$  (Snedecor and Cochran, 1967) and they are presented in Table 2.

RESULTS AND DISCUSSION

From the normal equations the regression coefficients  $b_0$  to  $b_5$  were calculated. The equation of the fitted regression was

$$Y = 342.352769 - 0.398050 X_1 - 9.194617 X_2 - 1.664068 X_3 - 0.281092 X_4 + 0.014428 X_5$$

Table 1 gives the analysis of variance of the significance of the regression coefficients. From this table it could be seen that the regression coefficients are all significant ( $p < 0.001$ ) indicating that the fitted model was capable of explaining a significant part of the variability in the biomass of planktonic forms with exoskeleton. The variability explained by the fitted regression model was 40%. The part of the variability unexplained by the regression model may be due to other variables which were not included in the model (Snedecor and Cochran, 1967). Though all the variables reported in the I. O. B. C. handbook (1967) were included in the regression model, still a large part of the variability was found to be unexplained. This emphasizes the fact that in future expedition data on more environmental factors like current, turbidity, depth stratification etc. are to be collected so as to get a good prediction model. Probably, by including the interaction of the factors, the prediction ability of the model can be further improved.

TABLE 1. ANALYSIS OF VARIANCE OF FITTED REGRESSION MODEL

Source	ss	df	ms	F
Regression	247.5687	5	49.5135	9.91***
Deviations	309.6662	62	4.9946	
Total	557.2349	67		

\*\*\* — Significant at 0.1 percent level

TABLE 2. RELATIVE IMPORTANCE OF THE VARIABLES INCLUDED IN THE REGRESSION MODEL

Variable	Relative importance
Temperature	0.4293
Salinity	1.6151
Phosphate-phosphorus	0.2404
Nitrate-nitrogen	0.7915
Oxygen	0.0036

The relative importance of the variables included in the regression model is presented in Table 2. From this table it could be seen that salinity is a prominent factor in the prediction of biomass followed by nitrate-nitrogen, temperature, phosphate-phosphorus and oxygen.

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## Model for Prediction of Planktonic Forms

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