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ENVIRONMENTAL STUDIES OF THE JINHAE BAY
2. ENVIRONMENTAL PARAMETERS IN RELATION TO PHYTOPLANKTON POPULATION DYNAMICS.

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ABSTRACT

1976년 7월부터 1979년 5월까지 3년간 진해만의 표층에서 격월로 식물성플랑크톤 군집 변화에 영향을 미치는 환경요인(수온, 염분도, pH, 투명도, 용존산소, Chlorophyll-a, c, NO_2-N 및 PO_4-P)에 대하여 조사했다. 9가지 환경요인이 식물성플랑크톤 군집 변화에 37.20% 영향을 미치고 있었으며 각각의 환경요인으로는 PO_4-P, 투명도, Chlorophyll-a, 수온, 염분도 등이 중요한 요인이었으며 용존산소, NO_2-N, pH 및 Chlorophyll-c는 크게 영향을 미치지 않고 있었다.

INTRODUCTION

Planktonic diatoms have often been used as indicators in marine ecosystem. Thus, the dynamics of the diatom population is strongly influenced by the environmental parameters therein. Recently, the environmental impact to the planktonic diatom population emphasizes extensively on the environmental factors.

The investigated area is known a little of the taxonomy and seasonal cycle of the phytoplankton populations (Park, 1956; Park and Kim, 1967; Choe, 1967 and 1969; Yoo and Lee, 1976; Cho, 1978; Yoo and Lee, 1979; Cho, 1979). And physico-chemical investigations were carried out for currents and chemical contents (Kang, 1972; Won and Park, 1973; Lee *et al.*, 1974; Lee *et al.*, 1974; Kwak *et al.*, 1975; Kim *et al.*, 1976; Lee *et al.*, 1978).

The purpose of the present research was to investigate environmental factors influencing on the total diatom standing crops, which was adopted a multiple regression analysis for the correlation between standing crops and environmental factors (water temperature, salinity, pH, transparency, dissolved oxygen, chlorophyll -a, c, NO_2-N, PO_4-P).

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MATERIALS AND METHODS

Samples were collected bimonthly from 6 stations in the Jinhae Bay during the period from July 1976 to May 1979 (Fig. 1). Sampling, analysis of phytoplankton and physico-chemical data were obtained by authors (Yoo and Lee, 1979).

The stepwise multiple regression analysis which was done in this study was performed on the environmental and diatom data using the Package-SPSS (Nie, 1975) for the statistical analysis.

This program writes a regression equation for the dependent variables in series of steps,

$$y=b_0+b_1x_1+b_2x_2+\cdots\cdots+b_ix_i$$

where

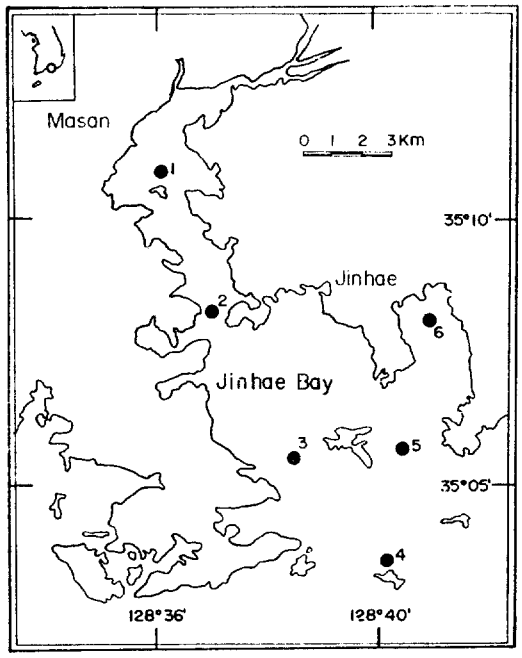

Fig. 1. Station map in the Jinhae Bay.

y: dependent variable (phytoplankton standing crops)

x_i: environmental parameters

b_i: partial regression coefficients and expresses how much y would change for a unit change in x_i

b_0: y intercept, the value of y when x_i's are all zero

Partial F-value for variables in the model was examined and significance level at 95% was established. R^2 values and standard deviations were also examined for the overall value of the model.

In this research, the regression was pooled the total diatom standing crops and environmental data.

RESULTS AND DISCUSSION

The results of the multiple regression analysis of the total standing crops of the diatom communities are summerized in Table 1.

The R square of this model is 0.3720 which indicates about 37.20% of variance in the standing crops may be explained by the 9 independent variales, while 62.80% of the variance in the standing crops remains unexplained by the potential independent variables.

The criterion of importance is based on the reduction of sums of squares, and the independent variable most important in this reduction in a given step is entered in the regression (Nie, 1975). The order of % importance which influenced on the total diatoms standing crops are Table 1. Among the variables of Table 1, PO_4-P, chlorophylla-a, water temperature, transparency, salinity were represented as the important factors which have influenced on the total diatoms standing crops. But dissolved oxygen, NO_2-N, pH and chlorophyll-c have showed relatively low significance.

In this research the most factor which have highly influenced on the primary production was PO_4-P (23.04%). Park (1975) pointed out that PO_4-P caused from industrial activities around Hengam Bay was diffused to whole area of the Bay gradually. Consequently high significant PO_4-P by waste water of Masan, Jinhae city and industrial activities in the adjacent land seemed to be caused the eutrophication to promote phytoplankton populations growth.

Second factor which has influenced on the total diatoms standing crops was chlorophyll-a. This factor take for granted high correlation between chlorophyll-a and phytoplankton populations because the phytoplankton contains chlorophyll-a itself rather than that has influenced on populations growth.

Third, water temperature was 14.73% importance in this investigation. Shim (1977a), in his regression analysis involving phytoplankton standing crops with 9 environmental parameters in Western Canadian Coast, reported that

Table 1. Relationship between phytoplankton standing crops and environmental parameters (surface)
Sample size: 87
Coefficient of determination (R^2): 0.3720
Standard error of estimate: 1.8964
F(10, 76): 8.3779
Probability: 0.0000

Variable*	Corr. coef.	Partial F	Probability	Nor. coef.	Importance(%)
PO_4-P	−0.508	9.235	−0.07810	−0.39963	23.04
Chlorophyll-a	0.045	5.195	0.05206	0.38930	22.45
Water temperature	0.075	3.748	0.09510	0.25555	14.73
Transparency	−0.296	2.747	−0.08048	−0.19892	11.47
Salinity	0.267	1.322	0.71912	0.19174	11.06
D.O.	0.094	1.097	0.06896	0.12430	7.17
NO_2-N	−0.016	0.516	−0.00332	−0.07524	4.34
pH	0.736	0.246	0.52076	0.07260	4.19
Chlorophyll-c	0.006	0.024	0.00317	0.02704	1.56

* Significant variables at 95% level
% Importance=Absolute value of the Nor. coef. of x_i/Sum of the absolute value of the Nor. coefs. ×100

9 independent variables were significant variables giving an R^2 of 0.3415. Among 9 variables, he reported that season factors for the determination of variations in diatom standing crops appeared to be more important than physico-chemical factors. Smayda (1973) also indicated that the growth of *Skeletonema costatum* was controlled by temperature, light and nutrients and N and Si are pointing out as limited factor. Therefore, temperature which was showed high significance in this study is coincided that temperature controlled phytoplankton populations growth (Goldman and Carpenter, 1974).

Transparency and salinity were 11.47%, and 11.06%, respectively. Dissolved oxygen was 7.17 %. In general the dissolved oxygen in the water is taken up at the surface from the atmosphere until saturation is reached; the capacity of the water to absorb oxygen depends upon temperature and salinity (Kinne, 1962a and b).

NO_2-N, pH and chlorophyll-c which have influenced on the total diatom standing crops were neglectable.

Consequently the multiple regression of the diatom standing crop against environmental parameters (Table 1) suggests that PO_4-P, chlorophyll-a, water temperature may be more important in predicting the distribution of the standing crop than NO_2-N, pH and chlorophyll-c.

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