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BIOLOGICAL PROCESSES IN THE WATER COLUMN OF THE SOUTH ATLANTIC BIGHT.

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PHYTOPLANKTON

GABEX I

The major research effort in the past year was to analyze and interpret samples collected during GABEX I (April 1980). Two projects are presently underway and others will be initiated in the coming year. The first project is a detailed look at a wind-forced upwelling event that occurred during the GABEX-I study period. Participants working on this project are Yoder, Pietrafesa, Atkinson, and personnel from NASA-Goddard Space Flight Center. The purpose of the project is to follow the development of a wind-induced upwelling and its effect on outer shelf chlorophyll distributions. Shipboard, current meter, weather buoy, and aircraft measurements are being used to describe this event. An important subobjective of this study is to see if the new LANDSAT multispectral scanner (to be launched in 1982) can be used to determine ocean chlorophyll concentrations and with what accuracy. This instrument was aboard a NASA C-130 aircraft during GABEX I, and the results are being compared with shipboard chlorophyll and temperature measurements.

A second project is to use phytoplankton productivity measurements obtained during GABEX I and during other DOE-sponsored cruises to estimate primary and "new" production of the outer shelf during winter and spring (ca. Nov - Apr). Figure 1 shows the frequency at which different rates of primary production were observed during shelf break upwelling in response to frontal eddies or meanders. The average of the measurements shown in Fig. 1 is 1.8 $gC \cdot m^{-2} \cdot day^{-1}$. In contrast, Haines and Dunstan (1975) gave an average rate of primary production of 0.4 $gC \cdot m^{-2} day^{-1}$ for the outer shelf, and we feel that their rate is representative of non-upwelling conditions. Dr. T.N. Lee examined 4 current meter records from the winter-spring period and calculated that upwelling occurs approximately 53% of the time (i.e. onshore flow of relatively cold water). Combining the two different estimates of primary production (upwelling and non-upwelling conditions) with Dr. Lee's estimate of "up-

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welling days", we estimate that primary production is 200 $gC \cdot m^{-2} \cdot 6$ $months^{-1}$ on the outer shelf during the winter-spring period.

Table 1 gives the results of 3 different methods of estimating "new" production - i.e. that portion of primary production that is supported by nitrate rather than by recycled nitrogen. All 3 estimates assume a phytoplankton C/N ratio of 7.5. Estimates A assumes that all available nitrate within the euphotic zone is utilized to support the daily rate of primary production. Estimate B is similar to A except that we assumed a vertical eddy diffusion coefficient of 1 $cm^2 \cdot sec^{-1}$ between the euphotic zone and deeper water, and thus nitrate available on a daily basis is somewhat higher than for estimate A. Estimate C is from simultaneous $^{15}NO_3$ and ^{14}C uptake experiments and is the most direct measurement of "new" production. All 3 estimates yield wide ranges of percent new production, and this is primarily a result of a biomass effect. In the early stages of a phytoplankton bloom within upwelled waters, primary production is low because plant biomass is low. However, "new" production is high because nitrate is present at high concentrations. At the latter stages of the bloom, primary production is high, since plant biomass is also high. However, nitrate concentrations are lower than for the early stages of the bloom (i.e. nitrate has been converted into plant biomass), and thus a smaller percentage of the primary production is "new".

Tables 2 summarizes all known estimates of primary and "new" production for the Southeastern shelf during winter and spring. The 1974 estimate is that of Haines (1974) who assumed that primary production on the outer Southeastern shelf was similar to that of the outer shelf of the Middle Atlantic Bight. From the results of 4 seasonal cruises, Haines and Dunstan (1975) estimated primary production to be 100 $gC \cdot m^{-2} 6$ $months^{-1}$. Their measurements were obtained before physical oceanographers realized the importance of shelf break upwelling as a source of plant nutrients to the outer shelf. In 1979, Atkinson and Lee estimated the net nitrate flux to the

Southeastern shelf resulting from upwelling associated with frontal eddies. The 1979 estimates assumes that all upwelled nitrate is utilized by phytoplankton. The 1980 estimate is that described earlier where "new" production is from estimate C of Table 1. Table 2 illustrates the importance of considering the effect of shelf break upwelling on outer shelf primary and "new" production.

Middle-Inner Shelf Interaction Study

In the past year, we initiated a preliminary study of plankton processes of the inner and middle shelf. One of the purposes of this study was to help define specific problems to be addressed following GABEX II. To date, only 1 of 3 planned cruises has been completed, and thus we are not prepared to discuss the results. One of the goals of the study was to define important phytoplankton spatial scales of the inner and middle shelf at different times of the year. We are particularly interested in the across-shelf gradient in phytoplankton biomass and its relation to frontal structure. However, we also need to know how much variability exists within the inner shelf shoreward of the front. One approach to this problem is to use spectral analysis to define important scales of chlorophyll variability on the inner and middle shelf. Dr. J.O. Blanton is presently assisting us with this analysis of the data collected from the first cruise. Other measurements were made during the first cruise, including primary production and nitrate and ammonia uptake rates. With this information, we can estimate phytoplankton nitrogen utilization, and compare utilization with nitrogen available in the water column taking into account a rough estimate of zooplankton excretion. We expect that phytoplankton nitrogen utilization exceeds that available in the water column (including zooplankton excretion). If true, this would be good evidence suggesting that inner shelf sediments may be an important nitrogen source for the overlying water column. Processes which couple the nitrogen (and other nutrient) budgets of the water column and sediments of the inner shelf could be a topic of future research.

ZOOPLANKTON

All zooplankton samples from summer cruises in 1978 and 1979 have been analyzed. Hydrographic and particle size analyses/from these cruises were completed earlier (See 1980 Progress Report). These results will be submitted as a manuscript in autumn 1981 to an International Oceanographic Journal.

Particle size analysis for all spring cruises including GABEX I has been completed. Zooplankton analysis for 1979 is now underway and that of GABEX I should be completed by January 1982.

BIBLIOGRAPHY

Haines, E.B. 1974. Processes affecting production in Georgia Coastal waters. Ph.D. Thesis. Duke University, N.C. 118pp.

Haines, E.B. and W.M. Dunstan. 1975. The distribution and relation of particulate organic matter and primary productivity in the Georgia Bight 1973-1974. Estuarine and Coastal Marine Science 3: 431-441.

TABLE 1. Percent New Production during Upwelling

	ESTIMATES		
	A	B	C
Mean	78%	83%	50%
Range	19-100%	29-100%	3-100%
N	16	16	10

TABLE 2. Estimates of Outer Shelf Primary Production

November - April

	Production ($gC/m^2/6mos.$)	
YEAR	TOTAL	NEW
1974	75	4
1975	100	4
1976	100	7
1979	100	32
1980	200	100

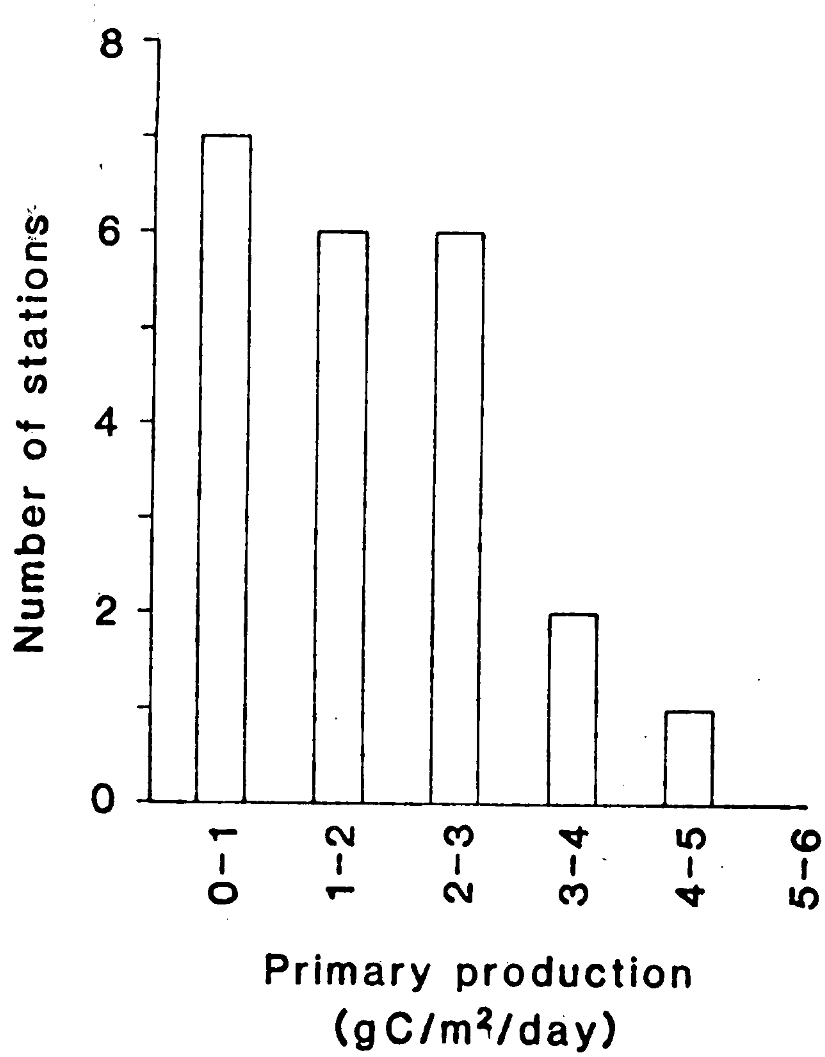

Fig. 1. Frequency of primary production estimates during upwelling.