NUTRIENT CONCENTRATIONS IN TIMBALIER BAY AND THE LOUISIANA OIL PATCH

by H. P. Burchfield, R. J. Wheeler, and W. Subra

ABSTRACT

The purpose of this study was to determine if petroleum drilling and/or production activities in Timbalier Bay and in the Louisiana oil patch contributed certain nutrients to the environment.

Samples were collected from August 1972 through January 1974. Water samples were analyzed for total alkalinity, dissolved silica, orthophosphate, ammonia nitrogen, and nitrate and nitrite nitrogen. Sediments were analyzed for total alkalinity and dissolved silica of the interstitial water and for total Kjeldahl nitrogen and total phosphate in bulk sediments.

Sampling locations included areas near oil platforms, at various distances and directions from the platforms, and at locations remote from the oil platforms.

Seasonal variations were shown for all of the nutrients studied.

Statistical comparisons between the platform sites and the ambient areas in the bay were possible only on three occasions. During these periods, no significant differences were shown among study areas.

Variations in most parameters were occasionally observed in close proximity to the platforms. Both elevations and reductions from ambient occurred; it is believed that they resulted from the structures' affecting mixing processes within the water column and from introductions by platform activities.

When this investigation was conducted the authors were at the Gulf South Research Institute, New Iberia, LA.

INTRODUCTION

This segment of the OEI study was designed to assess the effects of oil drilling and production activities on the nutrient concentrations of waters and sediments in Timbalier Bay and the Louisiana oil patch.

In the bay, sampling stations were established around a non-drilling production platform and an actively drilling workover rig. In addition, stations were established throughout the bay to assess natural seasonal variations and to serve as control sites.

In the offshore region, samples were collected near a production platform, at various distances from the platform, and along a transect from Timbalier Bay to the offshore platform.

Samples were collected from August 1972 through January 1974. Water samples were analyzed for total alkalinity, dissolved silica, orthophosphate, ammonia nitrogen, and nitrate and nitrite nitrogen. Sediments were analyzed for total alkalinity and dissolved silica of the interstitial water and for total Kjeldahl nitrogen and total phosphate in bulk sediments.

METHODS

Laboratory

Ammonia nitrogen was determined on a 50 ml sample of water, which was steam distilled in the presence of magnesium oxide for 3 minutes (Bremner 1965). The distillate was collected on 0.1 N HC1 and the resulting solution was tested for ammonia content after either Nesslerization or diazotization (Strickland and Parsons 1965).

Nitrite and nitrate nitrogen were also determined as ammonia, as outlined above, after steam distillation in the presence of magnesium oxide and Devardo's Alloy for a period of 5 minutes.

Orthophosphate was determined on a 100 ml sample treated with sulfuric acid and ammonium molybdate. The resulting mixture was extracted with ethyl acetate and the aqueous layer discarded; the remaining fraction was then treated with ascorbic acid and reacted with a tartrate compound to produce a blue color (Ho et al. 1970).

Silica was determined on a 25 ml sample, using the method described by Strickland and Parsons (1965).

Quantification was accomplished using a Beckman DU spectrophotometer for colorimetric measurements on all of the nutrients listed above.

Total alkalinity was determined by titration of a 100 ml sample to a pH of 4.5 and 4.2 with 0.05 N sulfuric acid.

In sediments, organic nitrogen was determined on a 0.5 g dried sample after digestion with sulfuric acid in the presence of K_2SO_4, $CuSO_4$, and Se. Sodium hydroxide was added and the mixture was steam distilled for 5 minutes. The distillate was then collected and quantified as described above for ammonia nitrogen.

Total phosphorus was determined as orthophosphate after digestion of a 1.0 g sample of dried sediment with sulfuric acid on a steam bath for 2 hours.

Field

The general locations of the stations sampled in Timbalier Bay and along a transect into the offshore region are shown in figure 1. More samples were taken in the immediate vicinity of the platforms, i.e., within 1,000 meters, than at the control sites.

RESULTS

Bay

Seasonal variations in the levels of nutrients in the bay are shown in figures 2 and 3 (pp. 227f). Nitrogen levels peaked during the winter months (November 1972 and January 1973), decreased during the spring (April 1973), increased in July in response to the heavy summer rainfall, decreased slightly in October, and then increased during the winter (January 1974). Phosphate levels (figure 3) followed a somewhat different pattern. The highest levels were observed during the fall (October 1972). They then decreased and remained relatively constant throughout the remainder of the study. Silica concentrations were highest during October of both 1972 and 1973 and minimal during the winter months (November 1972 and January 1973).

Levels of total phosphate, Kjeldahl nitrogen and interstitial water concentrations of dissolved silica are shown in figure 4. Phosphate levels peaked during the fall of both years and were remarkably similar at the control and production platform sites. Nitrogen levels increased during the winter of 1972, a period when the phosphate levels were decreasing, but followed a pattern similar to phosphate in the summer and fall of 1973. Enrichment of nitrogen in the sediments around the platforms was indicated during the winter of 1972 and the spring of 1973. Silica levels increased at both study sites throughout the period.

Offshore

Seasonal variations in the levels of nitrogen, phosphorus, and silica were observed along a transect from Timbalier Bay to the offshore platforms (figures 5, 6, and 7).

(text continues on p. 231)

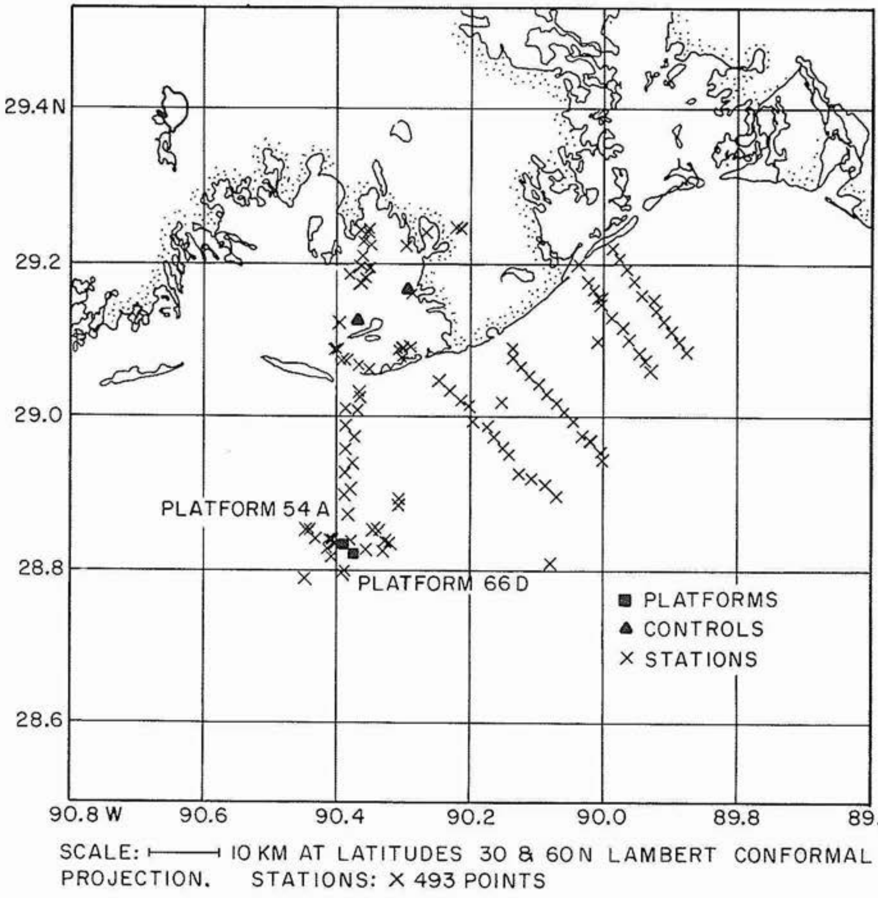

FIG. 1. NUTRIENT SAMPLING STATIONS.

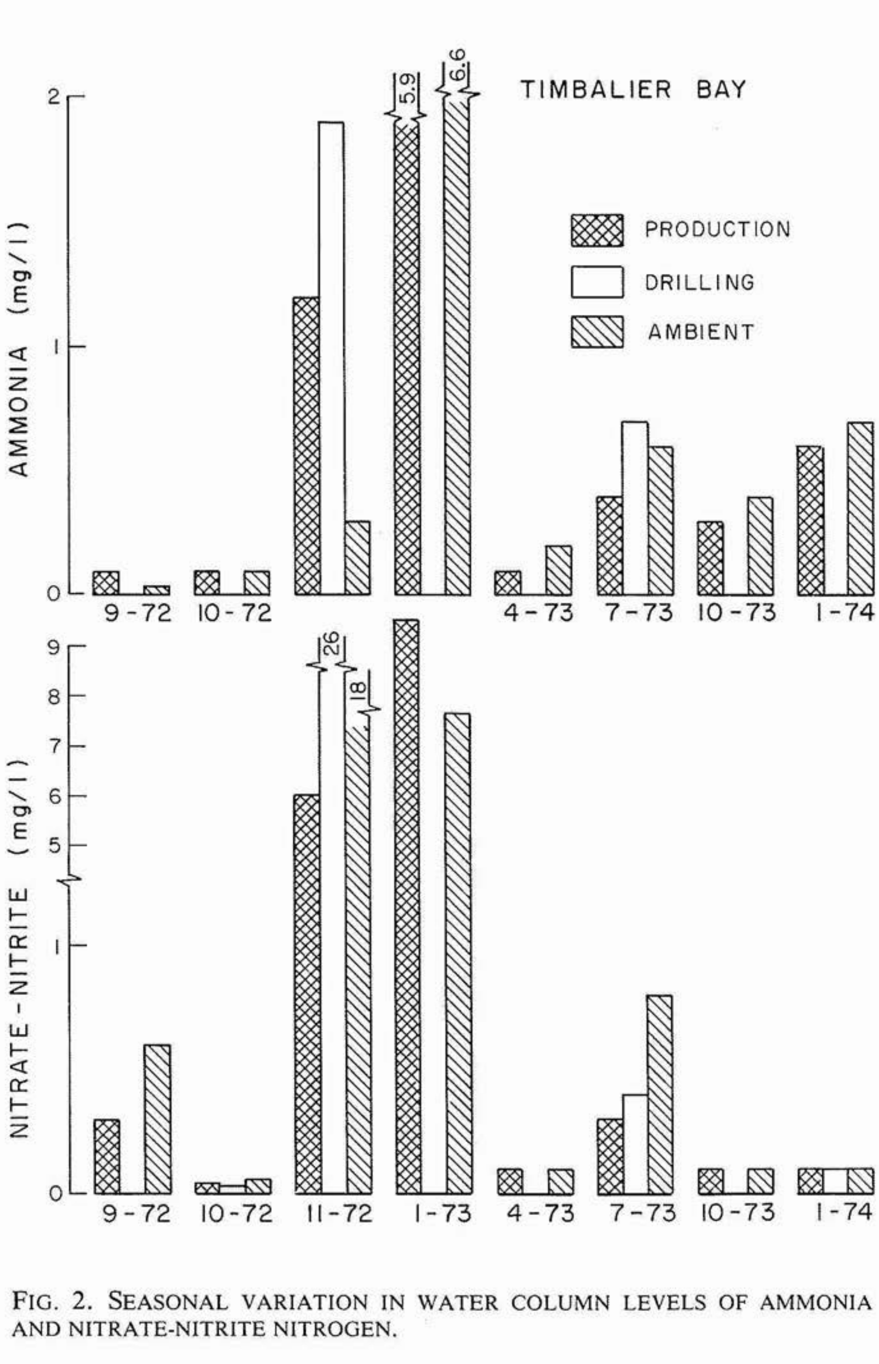

FIG. 2. SEASONAL VARIATION IN WATER COLUMN LEVELS OF AMMONIA AND NITRATE-NITRITE NITROGEN.

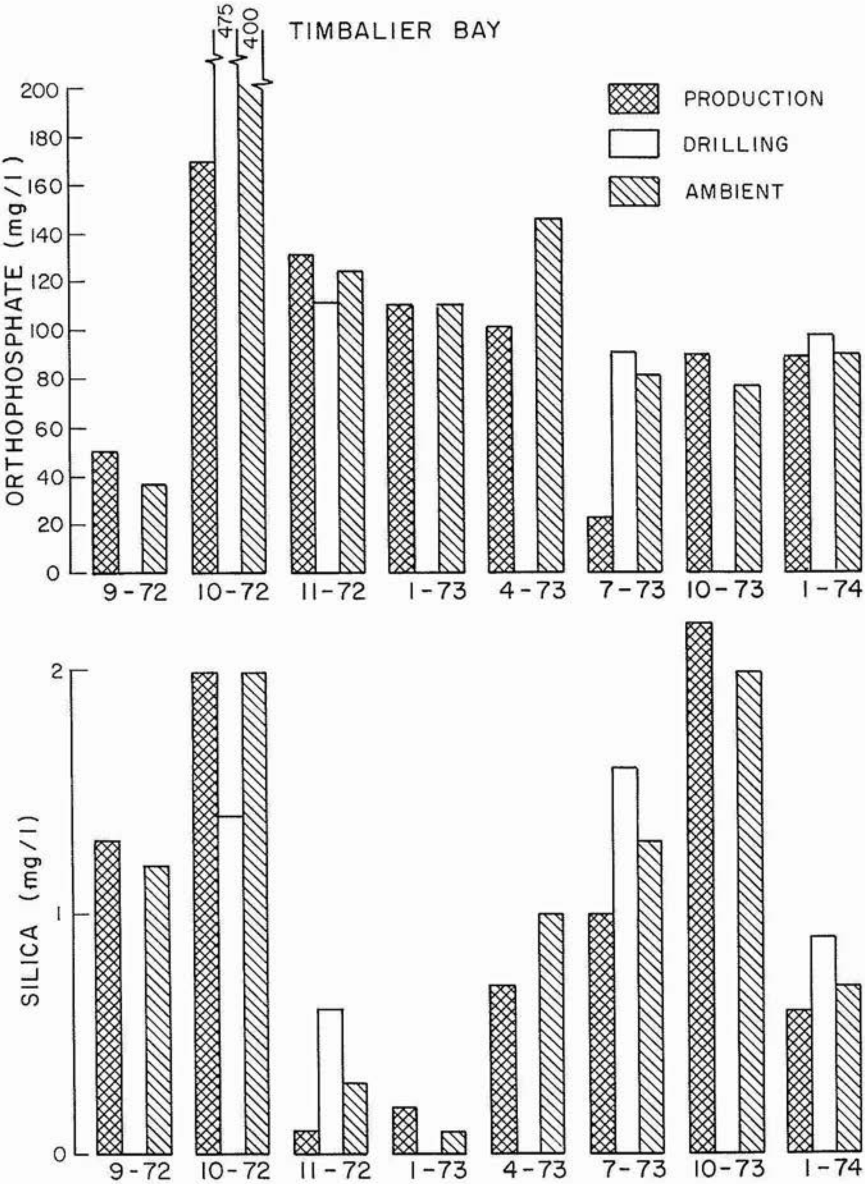

FIG. 3. SEASONAL VARIATION IN PHOSPHATE AND SILICA LEVELS.

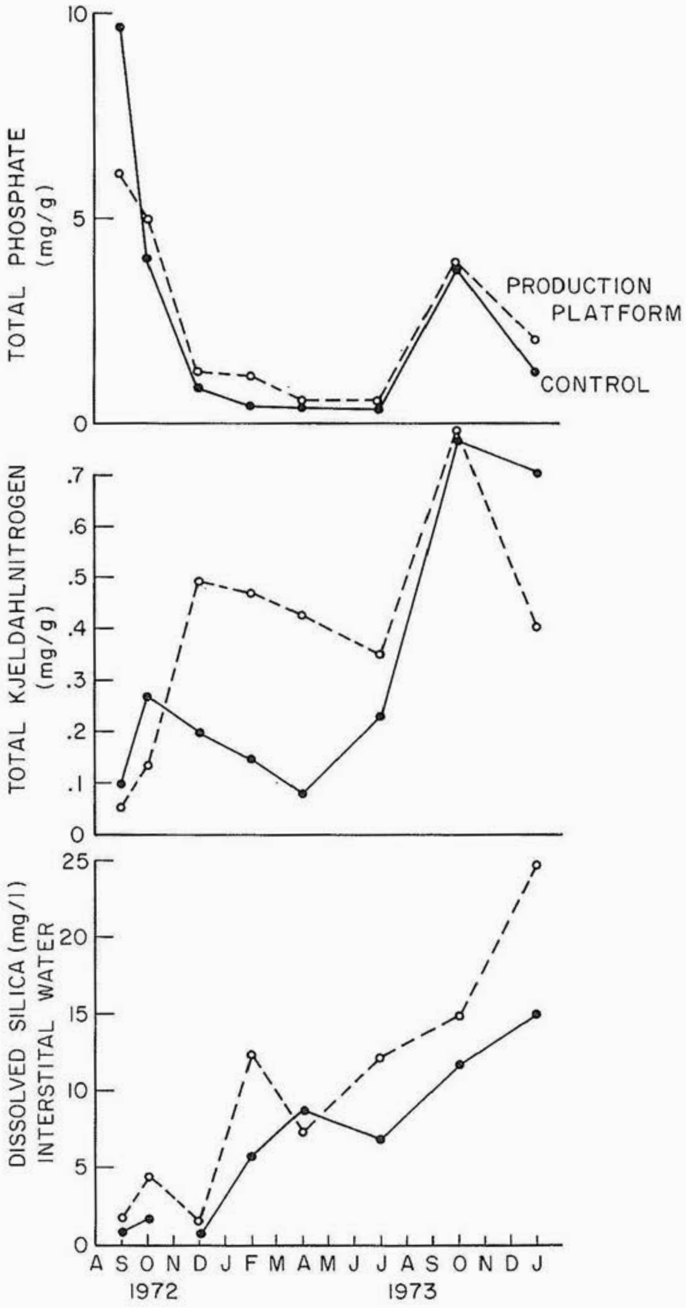

FIG. 4. SEASONAL VARIATION IN SEDIMENT AND INTERSTITIAL NUTRIENT LEVELS.

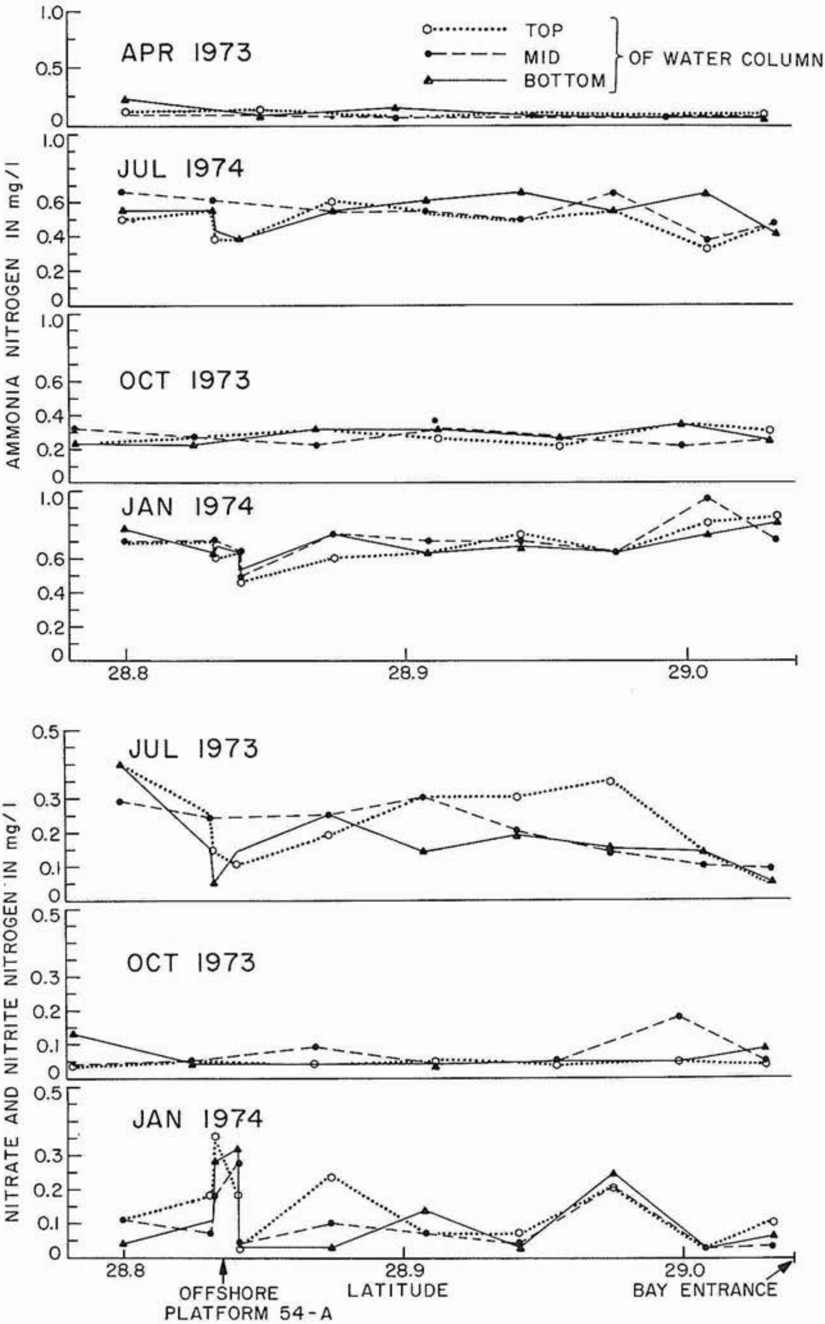

FIG. 5. AMMONIA NITROGEN ALONG BAY TO OFFSHORE TRANSECT (upper diagrams). NITRATE AND NITRITE NITROGEN ALONG BAY TO OFFSHORE TRANSECT (lower diagrams).

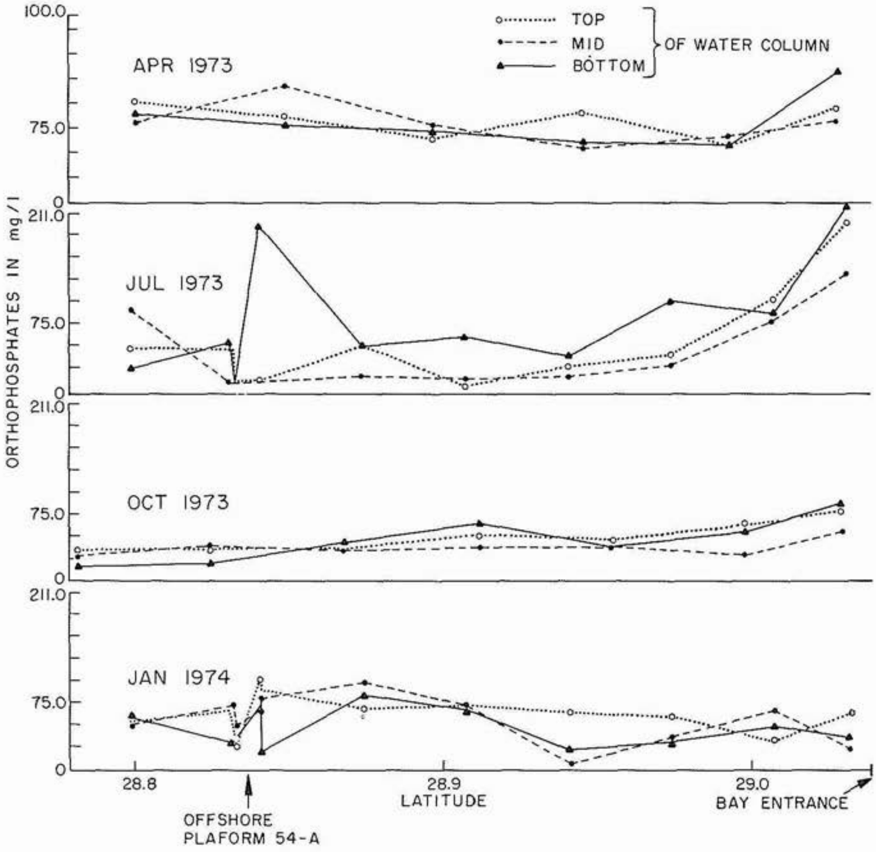

FIG. 6. ORTHOPHOSPHATE ALONG BAY TO OFFSHORE TRANSECT.

Ammonia and nitrate-nitrite nitrogen levels were low in April, increased in July apparently in response to the Mississippi River flood, decreased to near April levels during October, and then increased again in January.

Silica levels followed, in general, the trends observed for nitrogen, with concentrations low in April, increasing during the July flood period, decreasing in October, and then increasing in January. A relatively large increase in silica occurred in the bottom waters near the platform in July, and a similar increase was noted for phosphorus.

DISCUSSION

The seasonal variations in nutrient concentrations observed in this

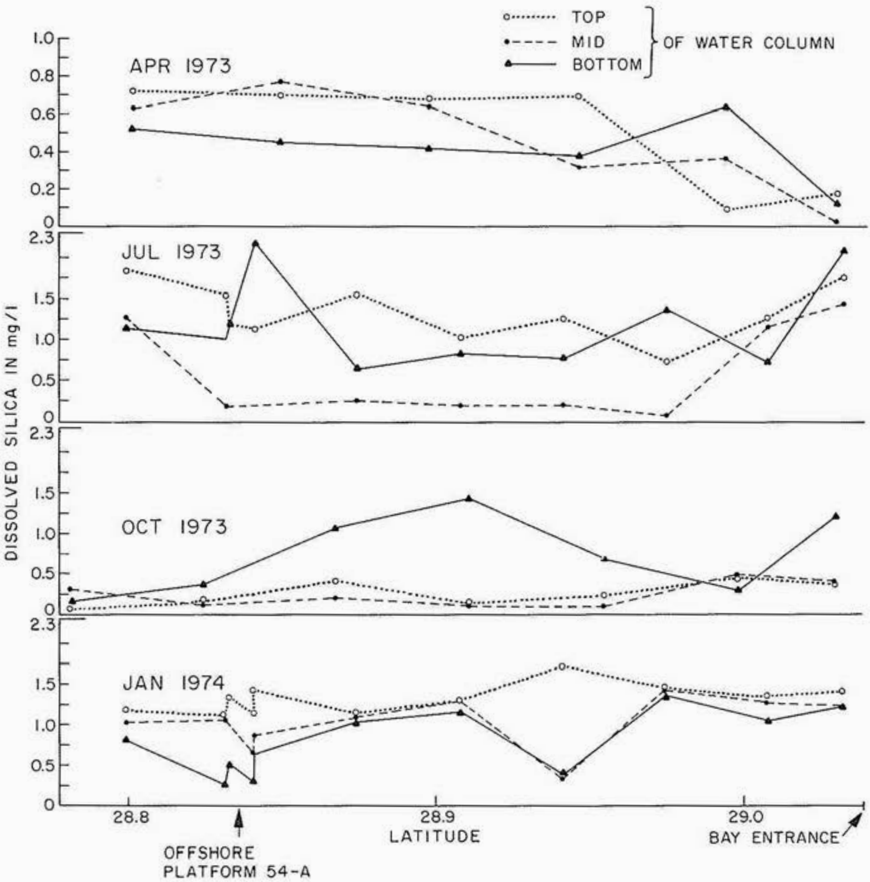

FIG. 7. DISSOLVED SILICA ALONG BAY TO OFFSHORE TRANSECT.

study of Timbalier Bay were generally comparable to the data collected by Barrett (1971) at two stations in the bay from January 1968 though June 1969. In this study, inorganic phosphate levels in south Timbalier Bay peaked in March 1968. Inorganic nitrogen levels were elevated in January 1968, then decreased progressively through February 1969.

Ho (1971) and Ho et al. (1970) reported seasonal variations of water and sediment nutrients in 1969 for three locations in Barataria Bay. Inorganic nitrogen concentrations in the bay in 1969 were high from late fall through early spring, decreased in April to a low that continued throughout the summer, and corresponded to the trends observed in Timbalier Bay from August 1972 through January 1974.

Phosphate in Barataria Bay ranged from a low of 2 $\mu g/l$ in April 1970 to a high of 120 $\mu g/l$ in July 1970. Phosphate was higher during the summer months of 1970 and lower during the colder months. In contrast, the orthophosphate values of Timbalier Bay were generally lowest during the summer months and higher during the colder months.

REFERENCES CITED

Barrett, B. B. 1971. Cooperative Gulf of Mexico estuarine inventory and study, Louisiana, Phase II, hydrology and Phase III, sedimentology. Louisiana Wildlife and Fisheries Commission.

Bremner, J. M. 1965. Inorganic forms of nitrogen, total -N and semi micro-Kjeldahl. *In* C. A. Black, ed., Methods of Soil Analysis. American Society of Agronomy **2**:1169-1178.

Ho, C. L. 1971. Seasonal changes in sediment and water chemistry in Barataria Bay. Louisiana State University Coastal Studies Bulletin **6**:67-84.

———, E. H. Schweinsberg, and L. Reeves. 1970. Chemistry of water and sediments in Barataria Bay. Louisiana State University Coastal Studies Bulletin **5**:41-56.

Strickland, J. P. H. and T. R. Parsons. 1965. A manual of sea water analysis. Fisheries Research Board of Canada Bulletin No. 125.