CEER-M-166

CHANGES IN DIEL PRIMARY PRODUCTION IN JOYUDA LAGOON ON JULY 7 AND 8, 1983

by

Roberto D. Rice
Gary Owen, M.S., Supervisor

August 1983

CENTER FOR ENERGY AND ENVIRONMENT RESEARCH
UNIVERSITY OF PUERTO RICO — U.S. DEPARTMENT OF ENERGY

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Research was conducted at the Center for Energy and
Environment Research under the auspices of
Oak Ridge Associated Universities
Summer Student Participation Program

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ACKNOWLEDGEMENTS

I am indebted to the Marine Ecology Division of the Center for Energy and Environment Research for providing the friendly and helpful personnel and the resources necessary for this investigation. I am especially grateful for the help and cooperation of Dr. Laurence J. Tilly, Dr. José M. López, Oliverio Serrano and Alfredo Mercado. I would also like to acknowledge Gregory S. Grose, Dennis N. Corales, Manuel Hernaiz, Carlos A. Bonafé and Capt. Angel L. Nazario for their help in data collection. Most importantly, I wish to thank Gary P. Owen for his time, support, guidance and understanding without which this report would not have been completed.

ABSTRACT

On 7 and 8 July 1983, a 28 hr study was conducted in Joyuda Lagoon. Dissolved oxygen, temperature and salinity measurements were taken at two hr intervals from seven regions within the lagoon and from one station within the channel, connecting the lagoon to the Guanajibo Channel. Unlike studies conducted in November and February, Joyuda Lagoon was found to have a north-south gradient for the study parameters. Primary production within the lagoon water column appears sufficient to meet planktonic respiratory and carbon requirements. The volume of water exchanged between the lagoon and the Guanajibo Channel was approximately equal, but the total volume of water flowing into the lagoon was insignificant in relation to its volume. Over an extended period of time Joyuda Lagoon may enrich the surrounding coastal waters. Plankton grazing appears to be significant in the lagoon.

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INTRODUCTION

Joyuda Lagoon is currently the subject of a series of studies which are attempting to determine how a tropical lagoon ecosystem functions. As one part in this effort, this study examines the level of planktonic primary production in Joyuda Lagoon during one event in the relatively wet season of July. In particular, it attempts to determine 1) whether this production is subsidized from the surrounding environment; 2) the significance and effect of coastal exchange and 3) what are the spatial and temporal patterns of production in the lagoon, and what are the underlying agents controlling these patterns.

DESCRIPTION OF STUDY AREA

Joyuda Lagoon is located in an area classified as a Subtropical Humid Forest (DRN, 1978-79). It is found on the west coast of Puerto Rico approximately 5 miles south of Mayaguez at Lat. 18'09"N, Long. 67'11"W (Pesante, 1978) (Figure I). It is approximately 1.6 km long, and 0.8 km wide, with a surface area of 121 hectares. The mean depth is 1.5 m, with a maximum depth of approximately 4 m (Garcia, 1981) (Figure II). A 15 to 20 meter band of mangroves (DRN, 1978-79) borders 75% of the lagoon (Pesante, 1978); the red mangrove *Rhizophora mangle*, predominates but black mangroves, *Avicenia nitida*, and white mangroves, *Laguncularia racemosa* are also found (Garcia, 1981).

Figure I. Study Area Site Localization.

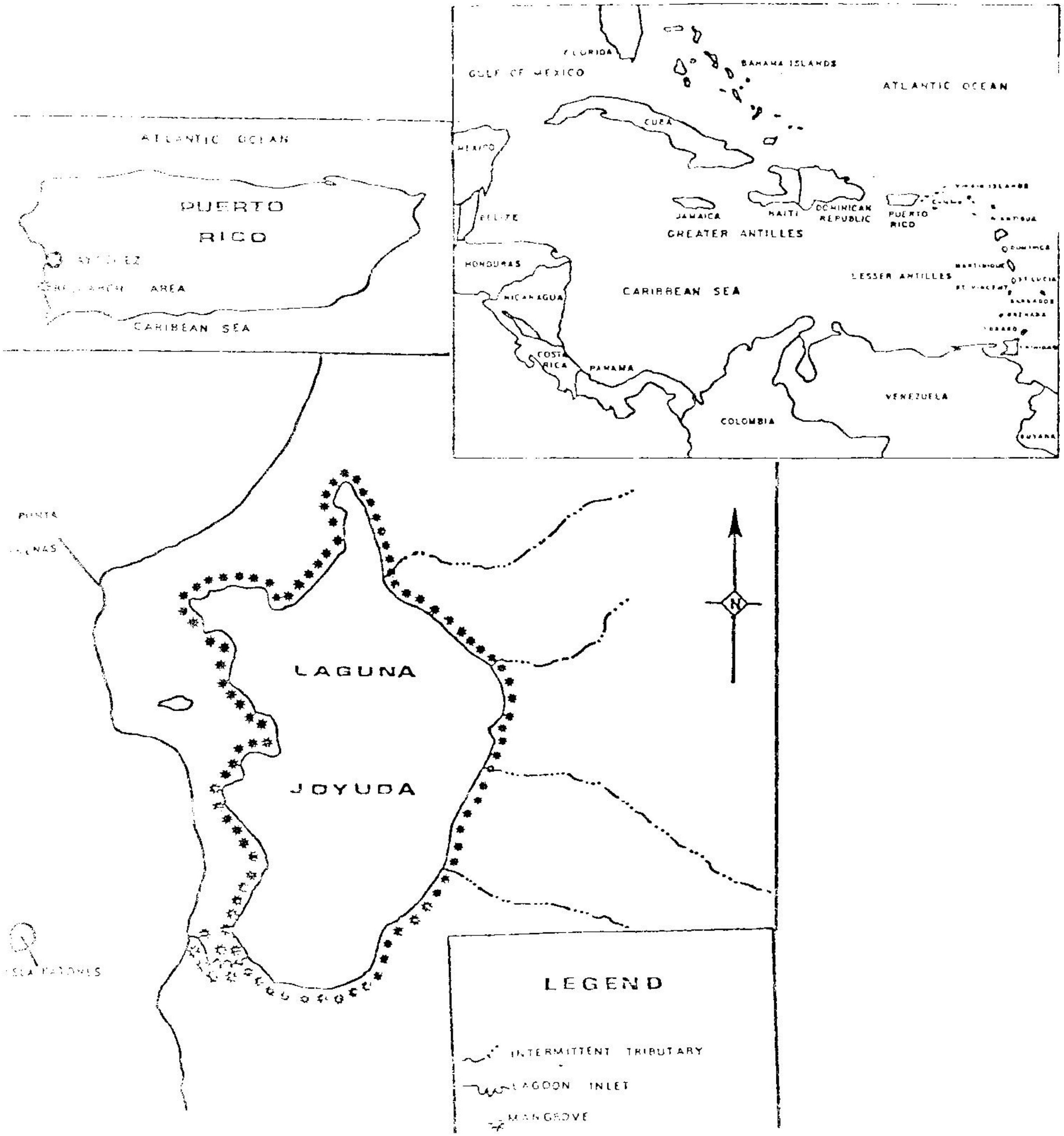
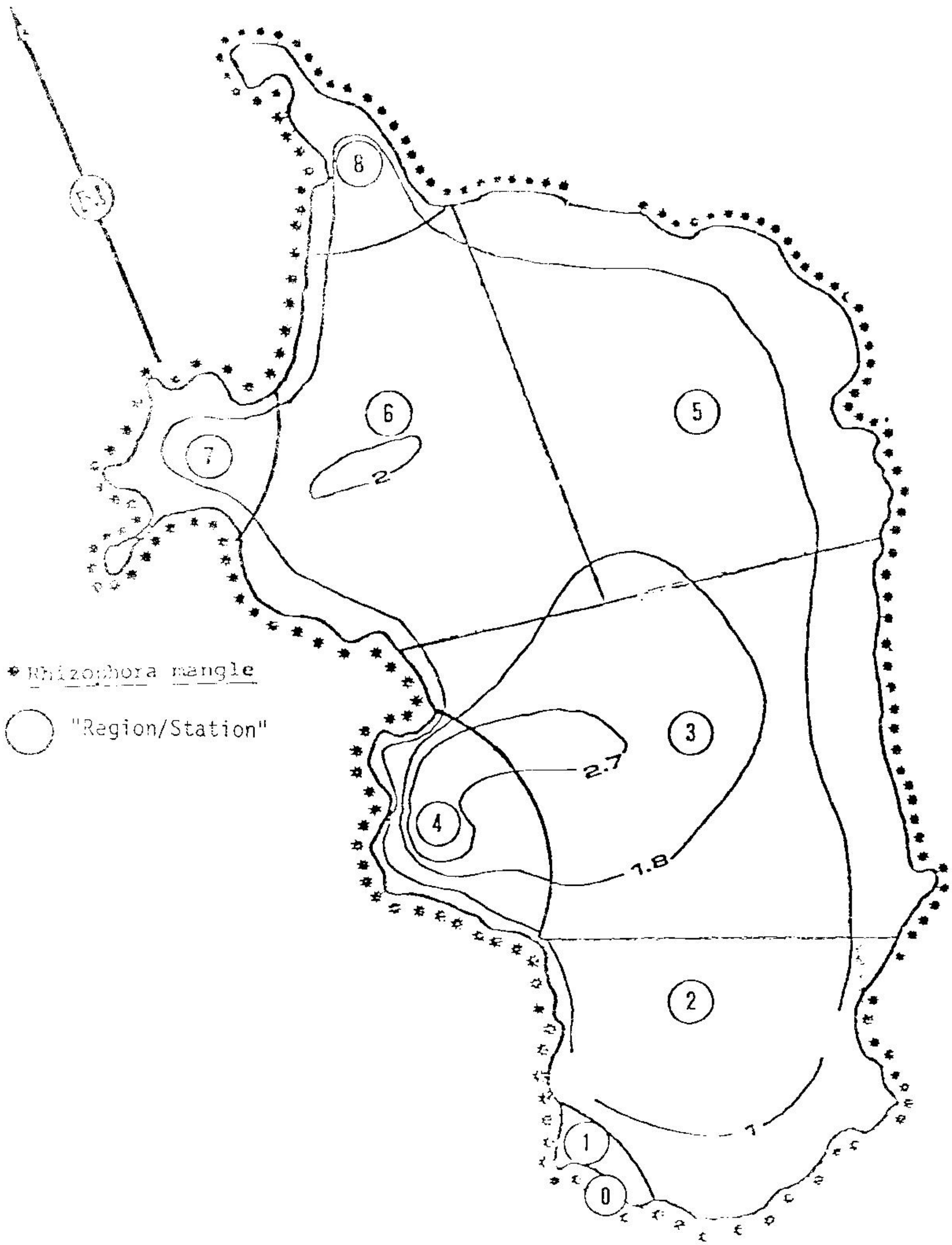


Figure 11. Sampling Regions in Joyuda Lagoon with Bathymetry in Meters.



MATERIALS AND METHODS

Field Procedure

During the 28 hr event on 7 and 8 July 1983, measurements of selected environmental parameters were taken every two hours from the 6 regions and 2 stations (0 and 3) indicated in Figure II. The regions and stations were chosen because of data collected in earlier studies at these locations. During all region and station occupations, measurements of dissolved oxygen (D.O.), temperature, salinity, and a sounding with a secchi disk were taken.

A temperature compensated D.O. meter was used for taking D.O. measurements (Y.S.I. Model 57, accuracy of ±0.1 ppm). A thermistor (Y.S.I. Model 57, accuracy of ±0.7°C) was used for temperature measurements and an induction salinometer (Y.S.I. Model 33, accuracy of ±0.7 ppt) was used for measuring salinity. Where the water column was greater than 0.5 m two replicate measurements for these parameters were taken at 0.25 m from the surface and at 0.25 m from the bottom. If the water column was less than or equal to 0.5 m (only at station 0), measurements were only taken 0.25 m from the surface.

Wind velocity (measured with a hand-held Dwyer Wind Meter) and wind direction (determined using a Saura HB-650 Compass) measurements were taken throughout the event, except within the channel, station 0, where the mangroves limit the ability to take accurate measurements. Secchi disk readings were taken between the hours of 0600 and 1800; cloud cover for the entire lagoon was also estimated during daylight hours.

Mean flow within the entrance channel, station 0, was determined from five measurements across the channel (with a Kahn 005WA200 Flow Meter

90% confidence of 0.17 m/rev ±0.097%) taken at 0.6 depth for 60 seconds. At the deepest spot in the channel, measurements were also taken at 0.2 depth and 0.8 depth so that average discharge could be better calculated (Linsley, et. al., 1975). Three complete ebbs and one flood cross sectional channel flow profile were determined during the course of the study. If a complete flow was not taken during the cycle then a spot flow check was taken at 0.6 depth in the deepest area. In this case, a minimum of two 60 second replicate samples were determined during the cycle. Chlorophyll samples were taken during eight cycles at station 3. A vertical Niskin sampling bottle (Model 1010-1.2 to 40L), with its mid-point designated as the sampler's depth in the water, was used to collect the water samples from the middle of the water column. Between two and four 135 ml samples were collected during each cycle. One ml of MgCO3 was added to the samples after filtering. After filtering, the glass micro-fiber GF/C filters (Whatman 4.25 cm) were stored in aluminum foil wrapped bottles and placed in a cooler with an ice-brine solution until they could be placed in a freezer (maximum time was 8 hours later) (Standard Methods, 1975).

Laboratory Procedure

Chlorophyll concentrations in the samples were determined by the fluorometric method after a 24 hr extraction with acetone (Standard Methods, 1975).

Statistical Analysis

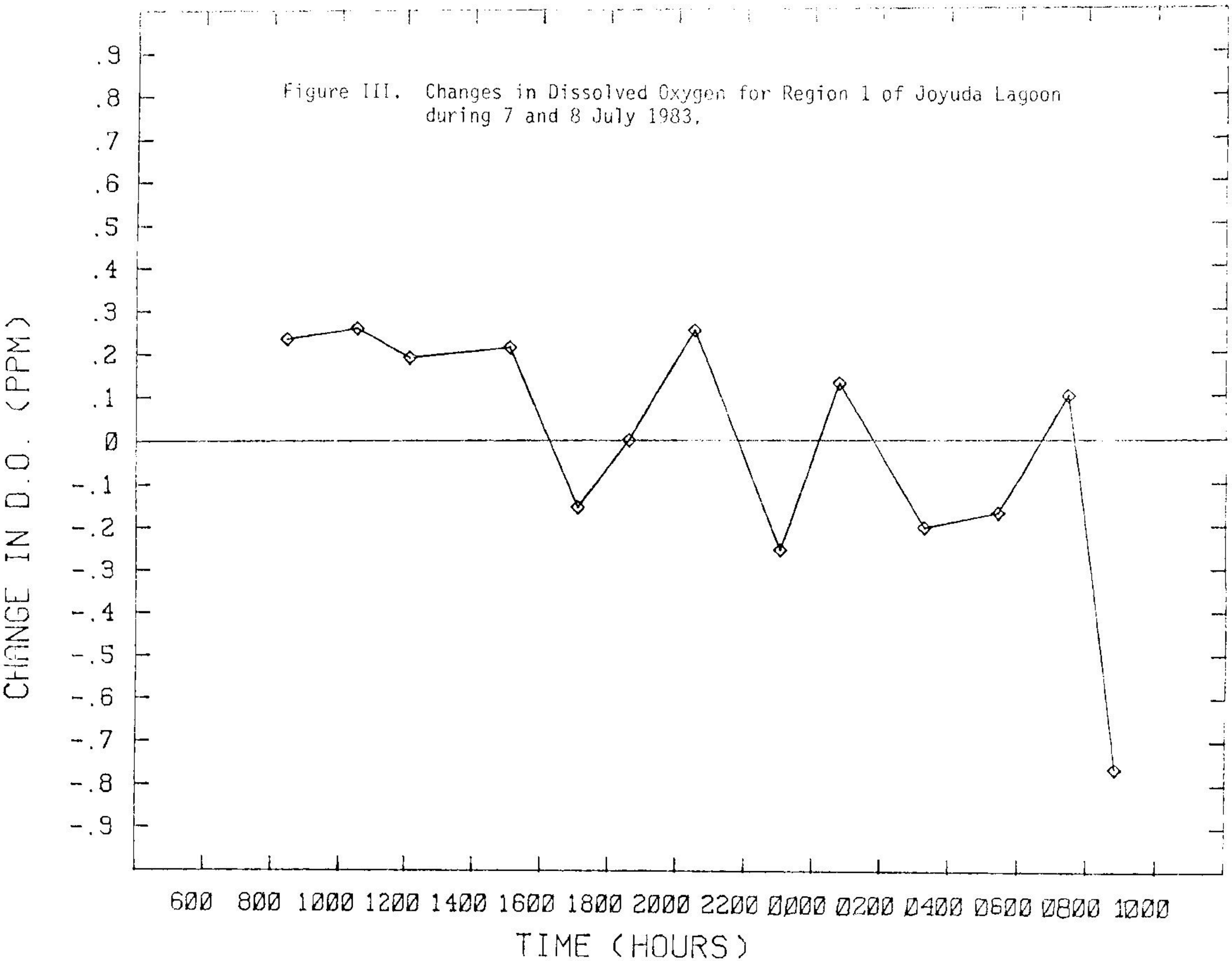
Station, time, depth, and the specific interaction effects for these parameters were analyzed for using analyses of variance techniques. Where there were indications of non-normal distributions or heterogeneous variance, a log transformation was made on the data. When spatial or temporal differences were observed SNK testing was used to determine their specific locations. Explanation of these statistical tests are presented by Sokal and Roth (1969).

Net production was determined by counting squares on the regional graphs of positive (non-transformed) changes in D.O. values versus time (Figures III-IX), and then multiplying this value by the mean depth for the region. Respiration was calculated using two times the negative changes, to account for respiration during times of net production. Gross production is the sum of the net production and respiration. The production/respiration ratio was calculated by dividing gross production by respiration.

Corrections in production and respiration for the gas exchange from Joyuda Lagoon to the atmosphere are small, 0.2% to 1.0%, relative to the observed oxygen changes (Tilly, personal communication). Due to the small size of this correction factor, and because the correction factor is not absolute, this correction was not made for the data.

The regional surface areas and their mean depths were determined by cutting the areas out from Figure II and passing them on a Mettler Balance, Type H6T dig (precision of $\pm$0.00005 g). Regional volumes were determined from this information (Table I).

Figure III. Changes in Dissolved Oxygen for Region 1 of Joyuda Lagoon during 7 and 8 July 1983.



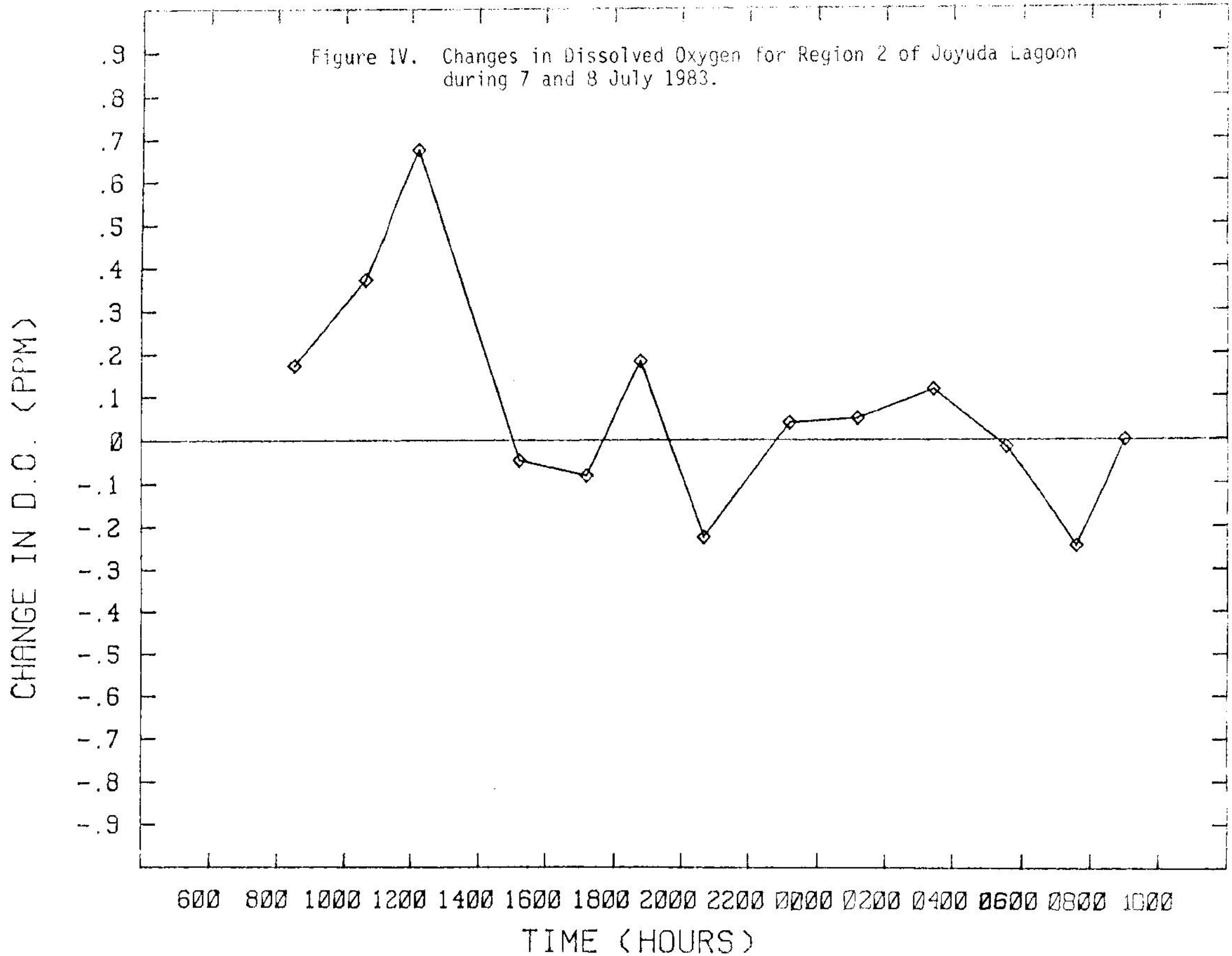


Figure IV. Changes in Dissolved Oxygen for Region 2 of Joyuda Lagoon during 7 and 8 July 1983.

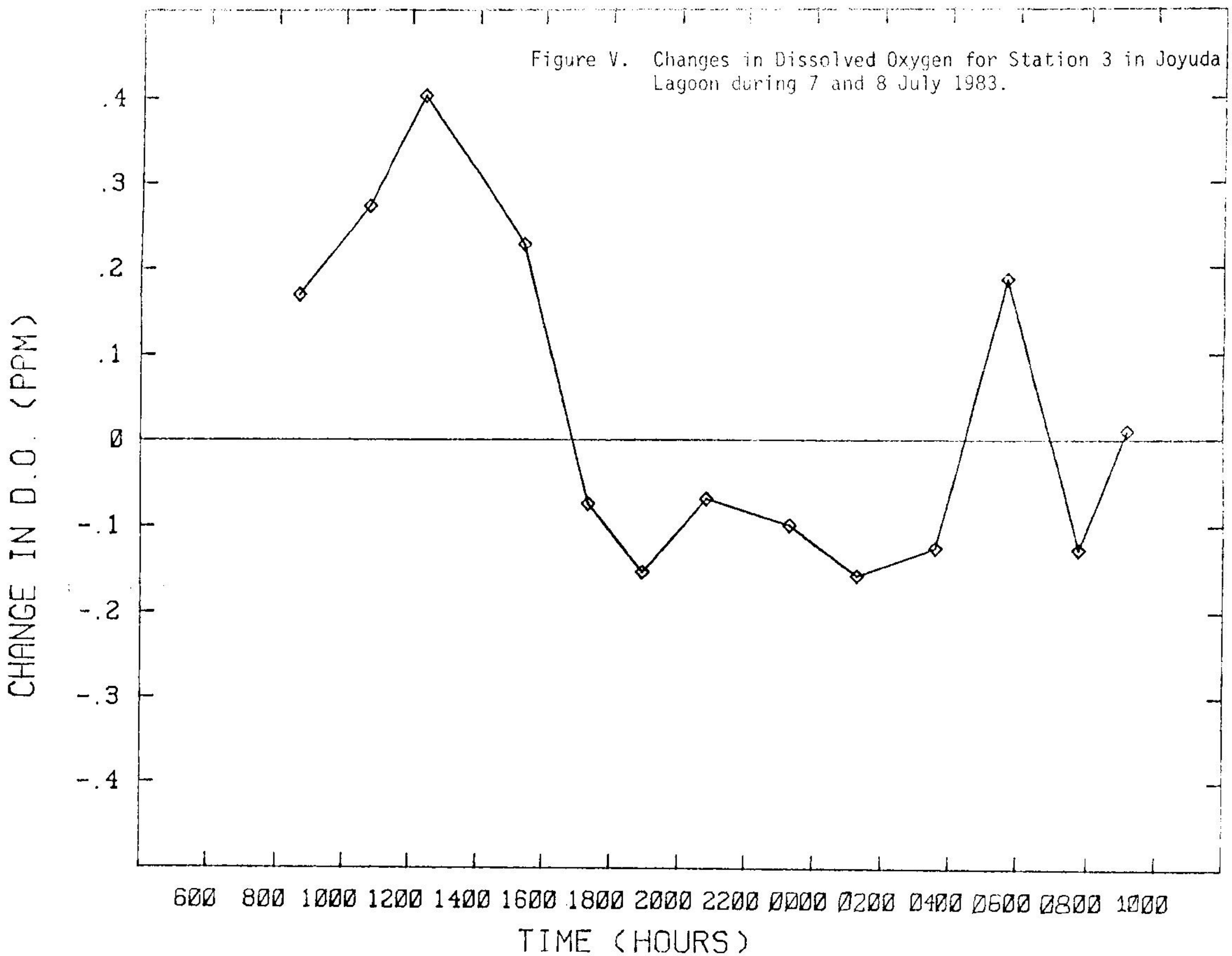
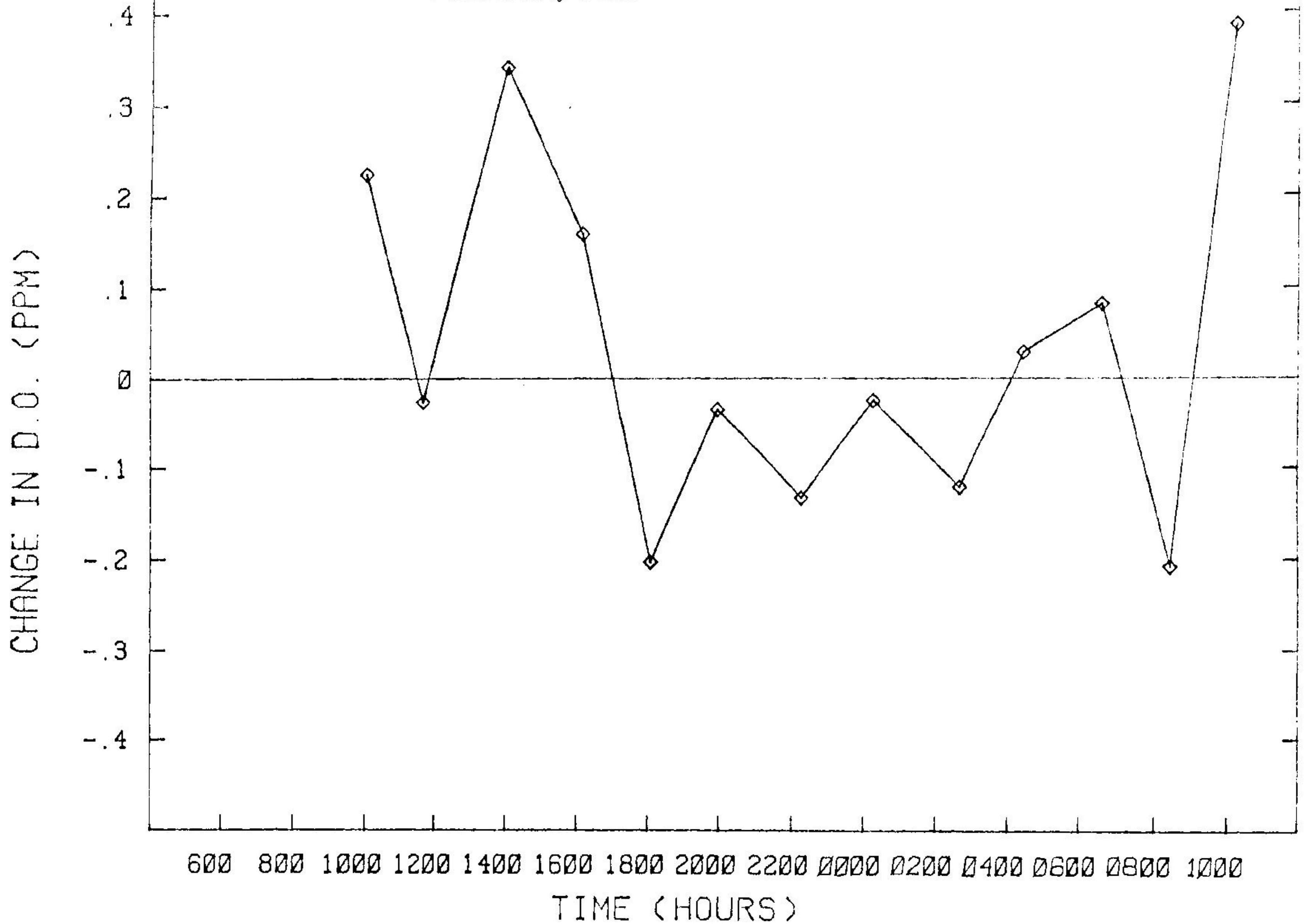


Figure V. Changes in Dissolved Oxygen for Station 3 in Joyuda Lagoon during 7 and 8 July 1983.

Figure VI. Changes in Dissolved Oxygen for Region 4 of Joyuda Lagoon During 7 and 8 July 1983.



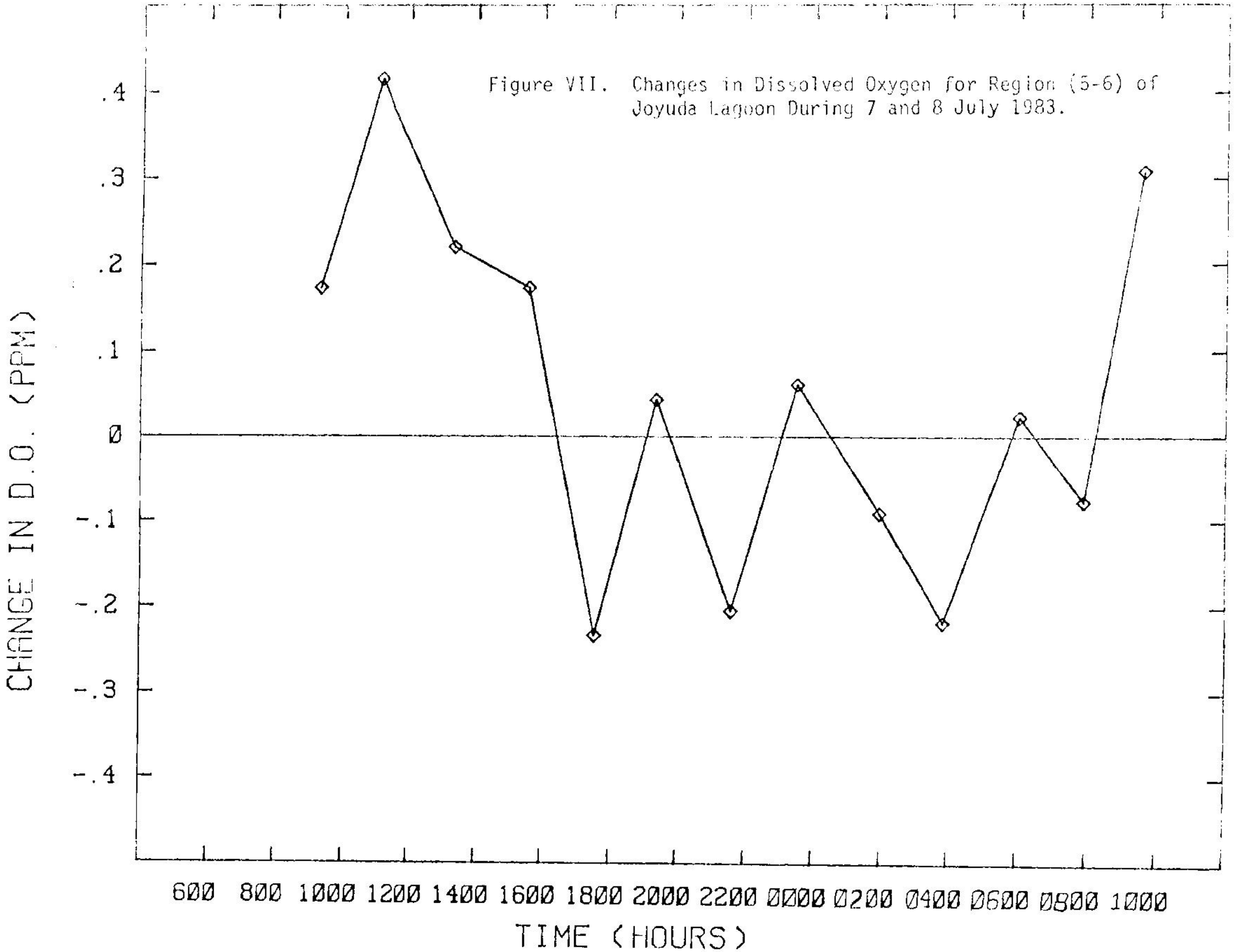


Figure VII. Changes in Dissolved Oxygen for Region (5-6) of Joyuda Lagoon During 7 and 8 July 1983.

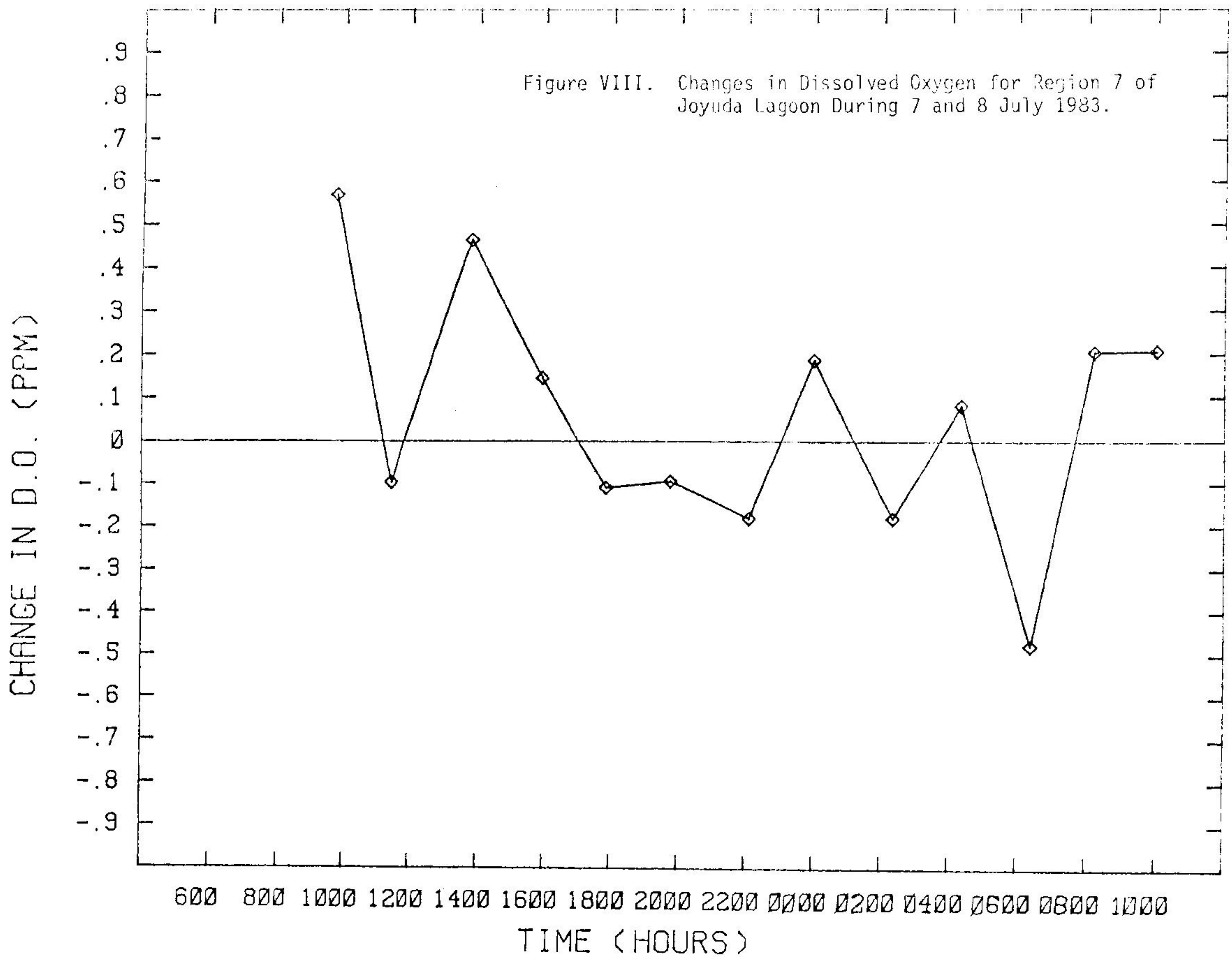


Figure VIII. Changes in Dissolved Oxygen for Region 7 of Joyuda Lagoon During 7 and 8 July 1983.

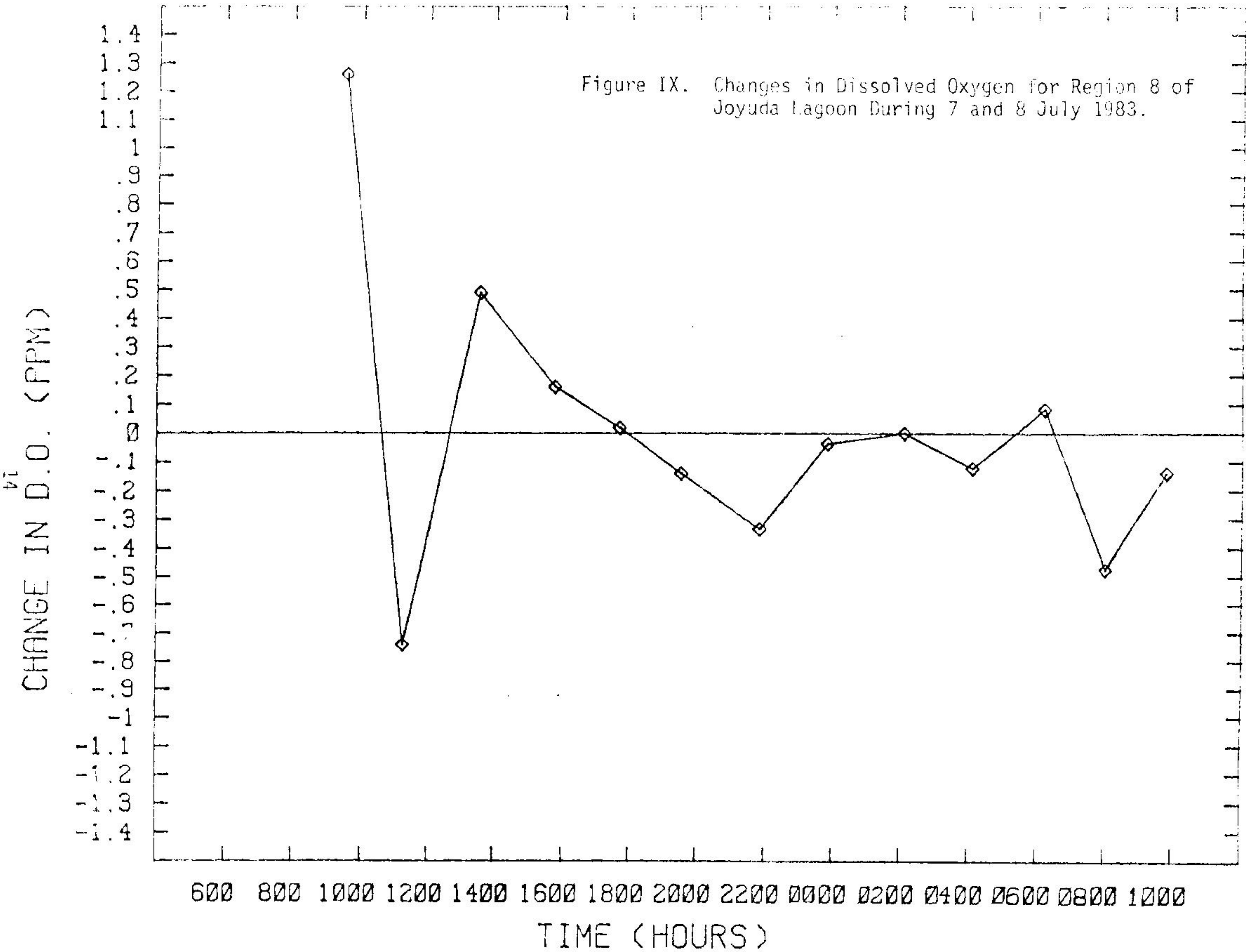


Figure IX. Changes in Dissolved Oxygen for Region 8 of Joyuda Lagoon During 7 and 8 July 1983.

TABLE I. Regional Mean Surface Areas, Depths, and Volumes for Joyuda Lagoon.

REGION	SURFACE AREA (m^2)	MEAN DEPTH (m)	VOLUME (m^3)
1	1.16×10^2	0.5	5.8×10^3
2	1.80×10^3	1.7	1.9×10^5
3	3.36×10^3	1.7	5.8×10^5
4	7.02×10^2	2.0	1.4×10^5
(5-6)	5.24×10^3	1.2	6.5×10^5
7	4.55×10^2	0.9	4.3×10^4
8	3.97×10^2	0.9	3.6×10^4
Σ	1.21×10^4		1.6×10^6
$\bar{x}$		1.3 ± 0.3	

RESULTS

Previous to the completion of this study a heavy storm occurred within the survey region which undoubtedly influenced the results presented here.

Dissolved Oxygen - The mean content of D.O. in the lagoon was 5.89 ppm; mean D.O. saturation was 6.6 ppm (89% saturation). Table II presents the significance of the different sampling parameters.

The lagoon was found to have a north-south gradient in oxygen with regions 7 and 8; station 3; regions 4 and (5-6); and regions 1 and 2 each statistically different (Table III). The magnitude of the mean non-transformed D.O. differences between these groupings were 1.00 : 1.10 : 1.14, respectively.

Diel D.O. concentration was found to be lowest between 0600 and 1000, increasing significantly at 1200, and reaching its peak at 1400. It then declined uniformly from 1600 to 0400. July 8th's 0600 and 0800 values wrapped around July 7th's values (Figure X and Table IV). The lowest mean D.O. was 4.98 ppm and the highest mean D.O. was 6.52 ppm, a 23.6% difference.

Mean D.O. was significantly higher, by 2%, at 0.25 m from the surface, 5.94 ppm, than at 0.25 m from the bottom, 5.84 ppm.

There were significant differences in regional relative mean D.O. ratios during the event. At different depths there were significant differences in D.O. among the regions and there were significant differences in mean D.O. throughout the day with respect to depth. D.O. also varied significantly within the different regions with respect to time and depth.

TABLE II. Anova Table for Dissolved Oxygen, Temperature, and Salinity for the Seven Regions Within Joyuda Lagoon for the Event of 7 and 8 July 1983.

SOURCE	df	D.O.[+] Mean Square	Temperature[+] Mean Square	Salinity[+] Mean Square
Region	6	.1925**	1.5866E-03**	2.0132E-03**
Time	13	.1414**	.0162**	.0325**
Depth	1	.0322**	-1.7166E-05	-3.6240E-05
Region x Time	78	.0102**	8.4403E-04**	1.1734E-03**
Region x Depth	6	1.7626E-03*	2.7116E-04**	5.5631E-05
Time x Depth	13	3.0799E-03**	1.8134E-04	8.3777E-05
Region x Time x Depth	78	1.3703E-03**	1.9810E-04**	8.6662E-05
Error	196	6.956E-04	2.0095E-05	1.0602E-04

[+] - a logarithmic transformation ($Log_{10}N$) was applied to the data.

TABLE III. SNK Multiple Comparison Test for Dissolved Oxygen, Temperature, and Salinity Among Regions in Joyuda Lagoon During the Event of 7 and 8 July 1983.

	Region	Region	Region	Region	Region	Region	Region
D.O.	8	7	(5-6)	3	4	1	2
Temperature	1 =	4 =	(5-6) =	7	2 =	3 =	8
Salinity	4	1 =	2 =	3 =	(5-6) =	7	8

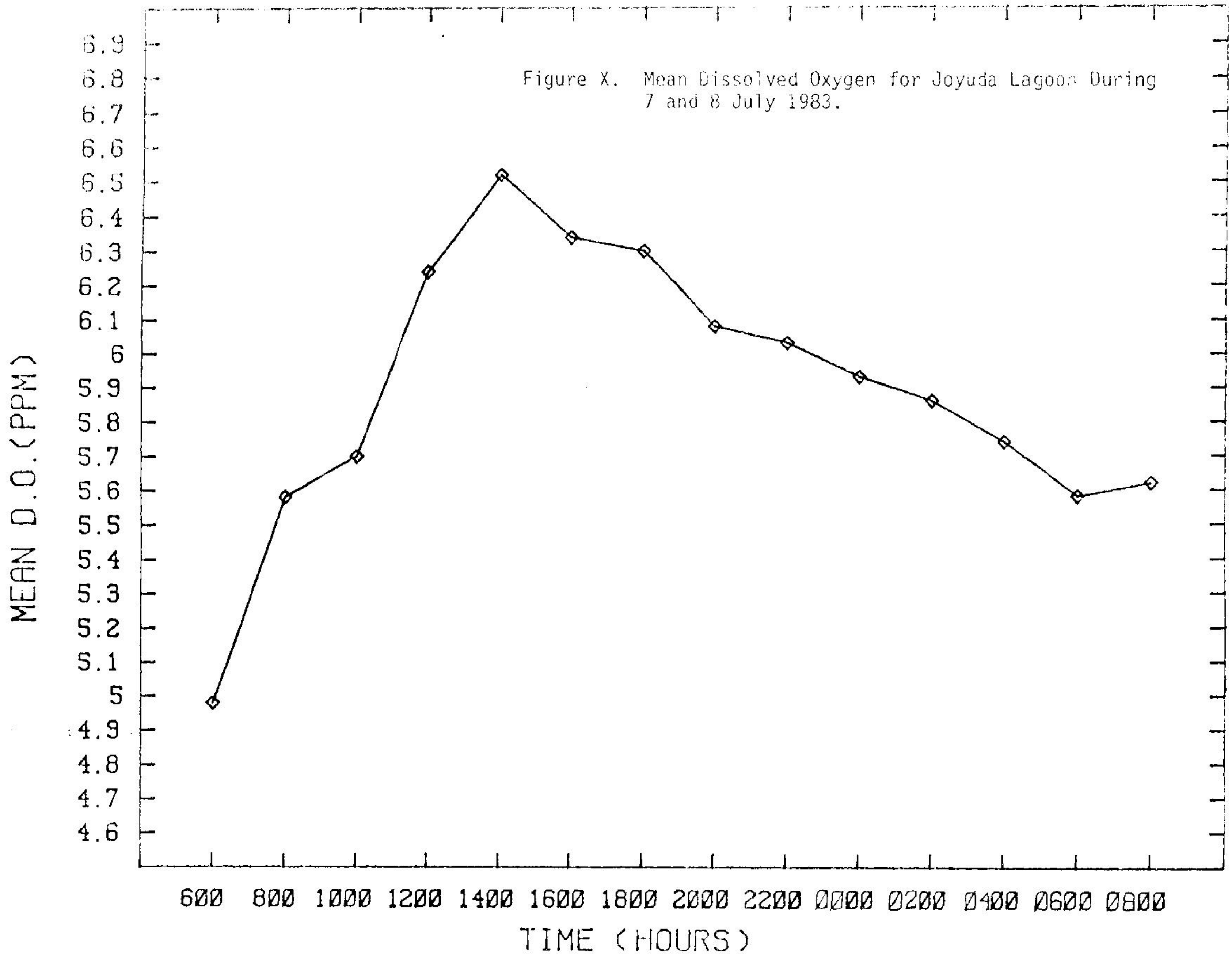


Figure X. Mean Dissolved Oxygen for Joyuda Lagoon During 7 and 8 July 1983.

TABLE IV. SNK Multiple Comparison Test for Dissolved Oxygen, Temperature, Salinity, Wind Velocity and Percent Cloud Cover among Different Times for Joyuda Lagoon During the Event of 7 and 8 July 1983 (p≤0.05).

	TIME	TIME	TIME	TIME	TIME	TIME	TIME	TIME	TIME	TIME	TIME	TIME	TIME	TIME
D.O.	0600T	0600F	0800T	0800F	1000	0400	0200	0000	2200	2000	1200	1800	1600	1400
TEMPERATURE	0800F	0600F	0400	0200	0000	2200	2000	1800	1600	1400	0600T	0800T	1000	1200
	0400	0800F	0600T	0800T	1000	1200	0600F	1400	1600	1800	0200	2000	0000	2200
WIND VELOCITY	2200	0600F	0400	2000	0200	0000	1800	0800	0600	0800	1400	1000	1600	1200
[illegible] DURING THE DAY	(0730) 0600F	(0530) 0400	(0850) 0800F	0600T	0800T	1000	1200	1800	1600	1400				

KEY:
T - Thursday; 7 July
F - Friday; 8 July
Number - When each sampling cycle should have begun
(Number)- When the sampling cycle actually began, if very different than when it should have begun

Production and Respiration - Table V presents information on net production, respiration, gross production, and the gross production to respiration (P/R) ratio for the different regions. The mean P/R ratio for the lagoon was 1.9 $\pm$0.034 g/m^2/day. Region 2 had the highest P/R value, 2.8 g/m^2/day, and region 8 had the lowest value, 1.3 g/m^2/day. Figures III-IX show that there is a large amount of fluctuation from the general trends of net production and respiration.

Temperature - The mean temperature for the lagoon was 28.8 °C. Table II presents the significance of the different sampling parameters. The magnitude of the regional effects was minimal. Region (5-6) had the lowest mean temperature value, 28.6 °C, and region 8 had the highest value, 28.9 °C. The mean temperature for the lagoon rose in the morning, peaking at noon with a value of 30.0 °C. As cloud cover and wind velocity increased in the afternoon the mean water temperature began its decline which lasted throughout the afternoon and evening until 0200 where it leveled off to its low value of 28.0 °C. At 0800 temperature began increasing again (Figure XI). Tables III and IV provide the regional and time SNK groupings.

The mean relationships of the temperatures between regions changed significantly throughout the event. It also changed significantly throughout the different regions with respect to depth, and with respect to both time and depth.

Salinity - The mean salinity for the lagoon was 26.5 ppt. Table II presents the significance of the different sampling parameters. Despite the significant regional effects, the range between the regions was only 0.6 ppt, a 2.2% difference. Region 4 had the lowest salinity, 26.2 ppt,

TABLE V. Net Production, Respiration, Gross Production, and Production/Respiration Ratio for the Seven Regions Within Joyuda Lagoon for the Event of 7 and 8 July 1983.

REGION	NET PRODUCTION G O_2/m^2/day	RESPIRATION G/m^2/day	GROSS PRODUCTION G/m^2/day	P/R
1	1.0	1.5	2.5	1.7
2	5.1	2.9	8.0	2.8
3	4.1	4.4	8.5	1.9
4	3.0	4.0	7.0	1.8
(5-6)	2.4	2.9	5.3	1.8
7	2.1	2.7	4.8	1.8
8	1.5	5.0	6.5	1.3
	2.7 ± 0.4	3.3 ± 0.2	6.1 ± 0.7	1.9

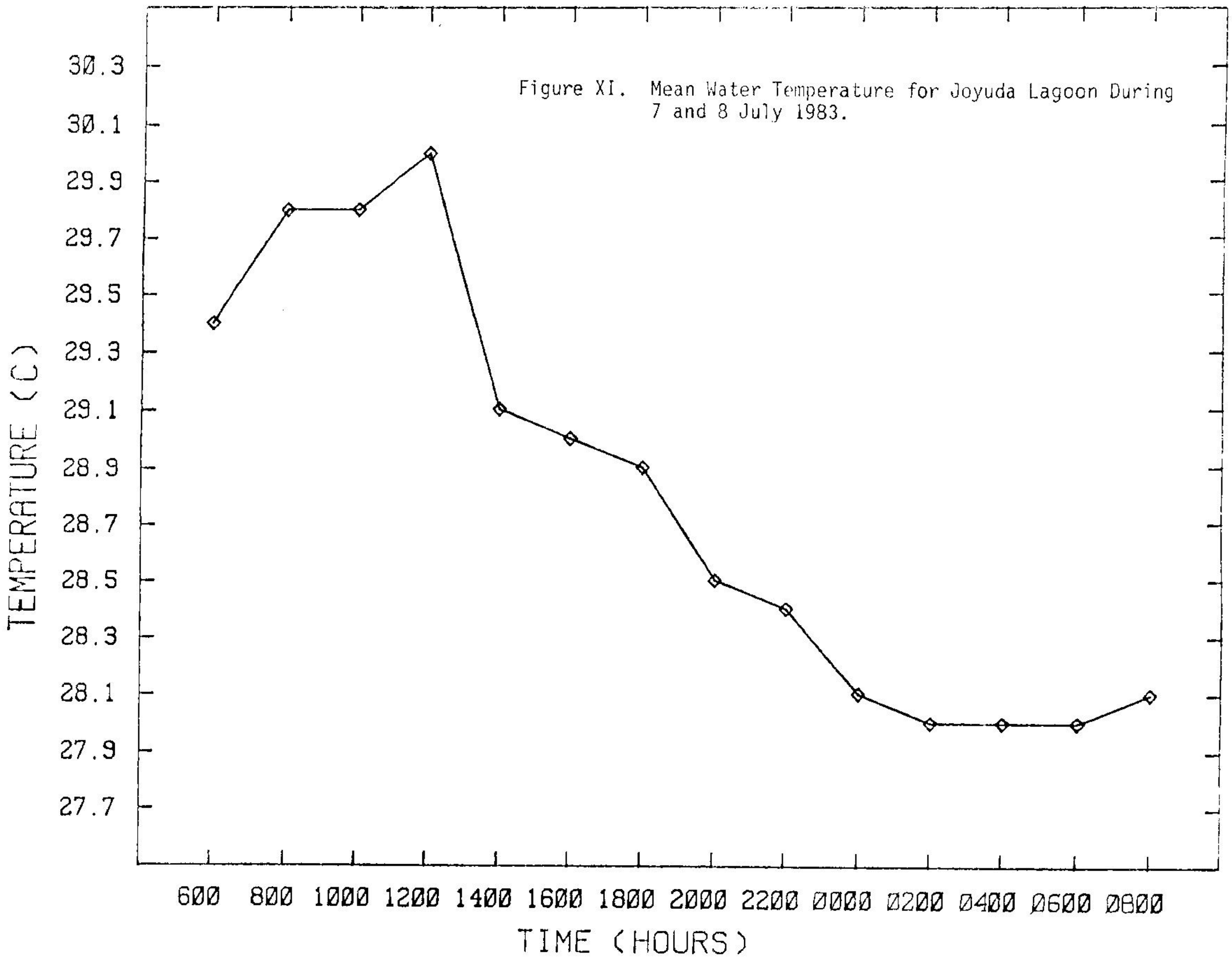


Figure XI. Mean Water Temperature for Joyuda Lagoon During 7 and 8 July 1983.

and region 8 had the highest salinity, 26.8 ppt (Table III). Salinity for the lagoon varied 15% with respect to time; if the lowest value, an unexplained anomaly, is excluded, it varies only 8.2%. Salinity increased during the day, reaching its peak value of 28.0 ppt at 2200 and then declined until dawn (Figure XII and Table IV).

Relative salinities between regions changed significantly throughout the event.

Chlorophyll - The mean value for chlorophyll was 5.97 $\pm$0.01 mg/m^3; there was no significant change in chlorophyll throughout the event.

Secchi Disk - There was no significant change in secchi disk readings as a function of time throughout the day. There was, however, a significant difference in secchi visibility between regions 8, 7 and 4. Mean secchi depth was 0.94 m. The differences in magnitude between the three regions were 1.00 ; 1.02 : 1.20, respectively.

Flow - Ebbs occurred at all times except during 1600, 1800, and 2000 sampling cycles when strong floods appeared. Due to great variance of unexplainable nature in the flow data, it is impossible to calculate the precise flow volumes. However, the total flood volume for the event appears to be equal to or higher than the total ebb volume. Despite this, the maximum flood volume (150 m^3 to 330 m^3) for a two hour period would be between 2.6% and 5.7% of region 1 volume, 0.00012% to 0.00027% of the total lagoon's volume.

Wind Velocity and Direction - The mean wind velocity for all regions in the lagoon during the event was 4.2 m.p.h. (Table VI). Wind velocity changed significantly throughout the event; it also differed significantly for the different regions. (Table VII presents the significance of the

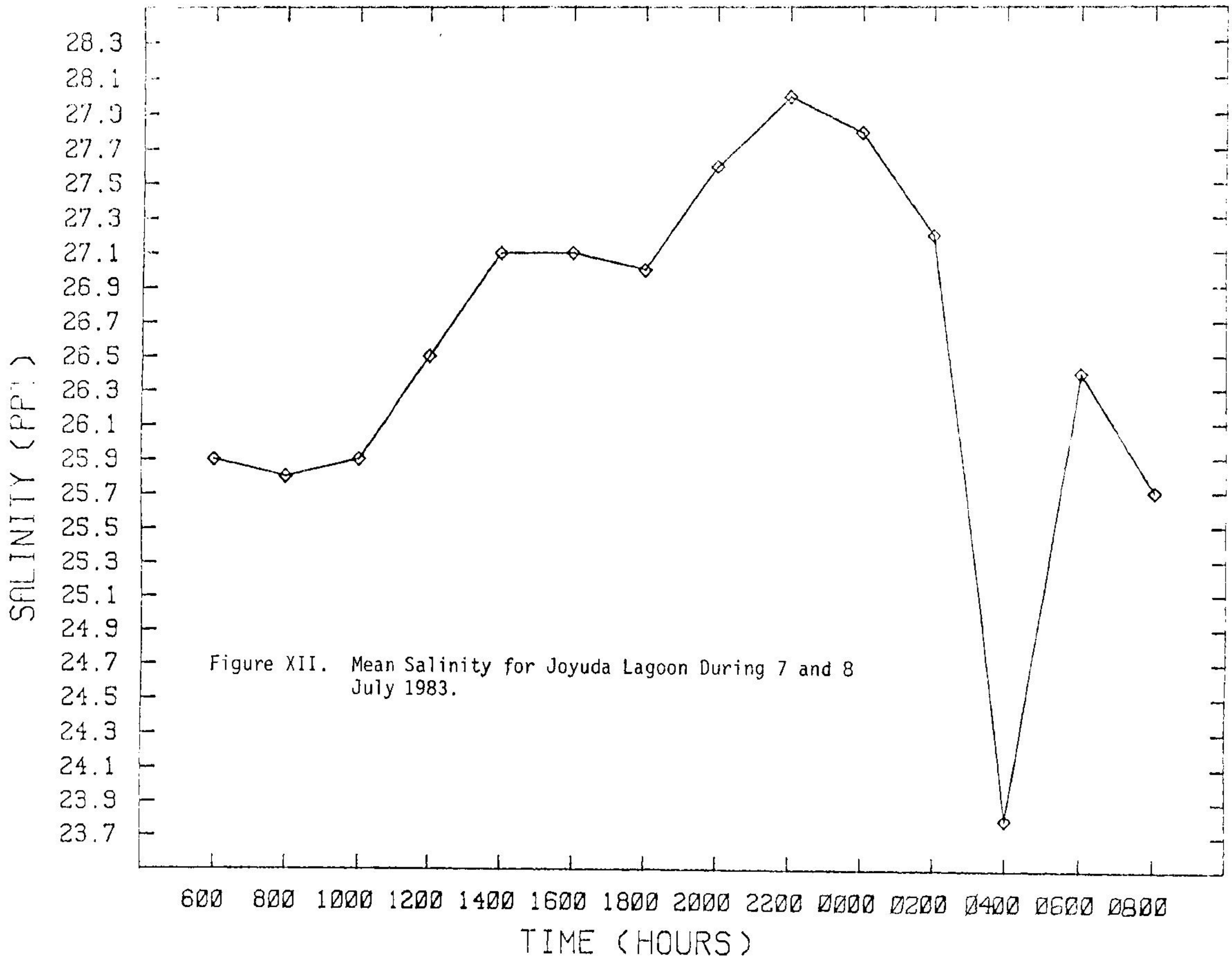


Figure XII. Mean Salinity for Joyuda Lagoon During 7 and 8 July 1983.

TABLE VI. Regional Wind Velocity and Direction for Joyuda Lagoon During the Event of 7 and 8 July 1983.

REGION	MEAN WIND VELOCITY (MILES/HOUR)	MEAN WIND DIRECTION (IN DEGREES)
1	3.1	90
2	4.3	116
3	4.8	119
4	4.7	131
(5-6)	4.9	123
7	5.2	135
8	2.4	149

TABLE VII. Anova Table for Wind Velocity+ for the Seven Regions Within Joyuda Lagoon for the Event of 7 and 8 July 1983.

SOURCE	df	MEAN SQUARE
Subgroups	97	14.3033*
Region	6	15.6412*
Time	13	77.6531*
Region x Time	78	3.6421
Error	0	0

+ - a logarithmic transformation ($Log_{10}N$) was applied to the data.

different sampling parameters). Wind velocity increased throughout the morning, peaking at 1200 with a mean velocity of 8.1 m.p.h. After 1600 the mean wind velocity declined rapidly developing into the lowest SNK grouping between 2000 to 0600 (Fri.), which had a mean velocity of 0.77 m.p.h. (Table IV and Figure XIII).

Wind direction in the southern part of the lagoon tended to be coming from the east, while wind direction in the northern part came from the south-east (Table VI).

<u>Percent Cloud Cover</u> - Cloud cover varied significantly throughout the day. (Table VIII presents the significance of the different sampling parameters). The mean cloud cover during the periods of daylight was 33%. During the early morning, percent cloud cover was lowest, with a mean value of 8 ±12%. Between 1200 and 1800 percent cloud cover was highest, 83 ±17% (Figure XIV and Table IV).

<u>Wind Direction</u> - Wind direction in the southern part of the lagoon tended to be coming from the east, while wind direction in the northern part came from the south-east (Table VI).

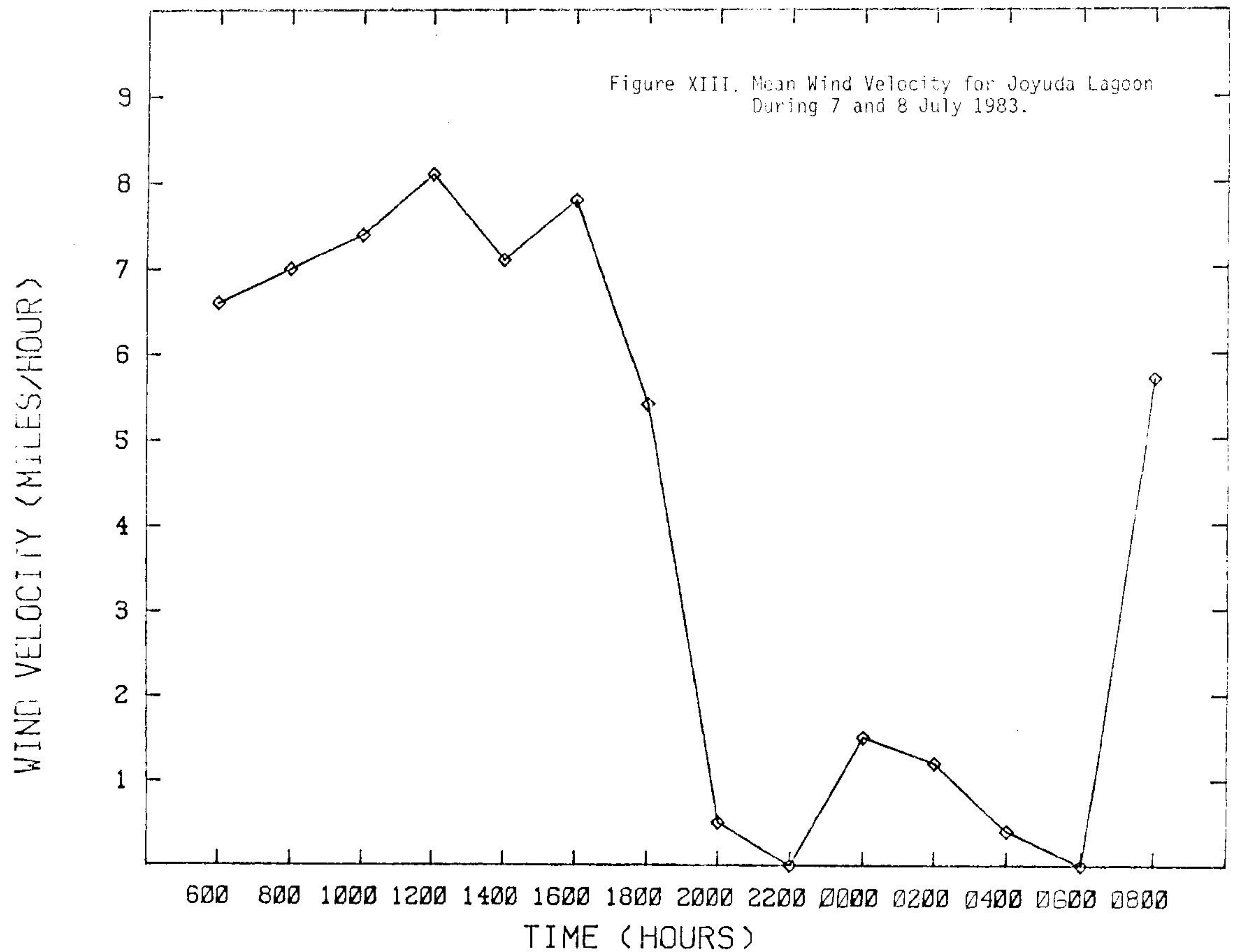


Figure XIII. Mean Wind Velocity for Joyuda Lagoon During 7 and 8 July 1983.

TABLE VIII. Anova Table for Percent Cloud Cover for the Seven Regions Within Joyuda Lagoon for the Event of 7 and 8 July 1983.

SOURCE	df	MEAN SQUARE
Subgroups	69	1285.7971**
Region	6	88.3333
Time	9	7795.8730**
Region x Time	54	333.8360
Error	0	0

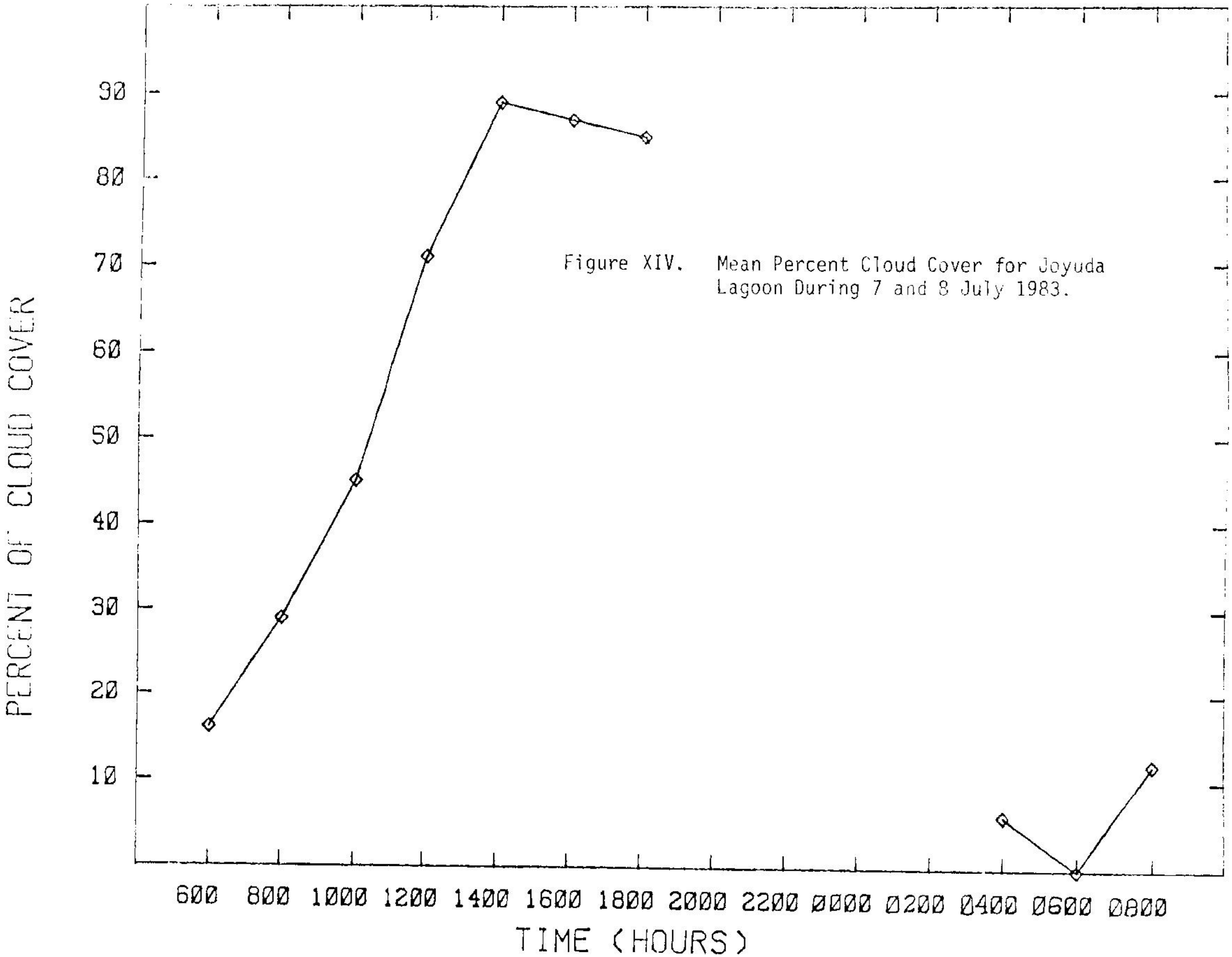


Figure XIV. Mean Percent Cloud Cover for Joyuda Lagoon During 7 and 8 July 1983.

DISCUSSIONS AND CONCLUSIONS

The P/R ratios (Table V) show that the water column in all regions of Joyuda Lagoon produced more carbon than they use. Consequently, it does not appear that the planktonic primary production needs a carbon subsidy from the surrounding environment.

The volume of water flowing through the Guanajibo channel is insignificant compared to the volume of water in region 1. Consequently, it would have no effect on the parameters measured in the lagoon because of the limited period of study. However, it is of interest to note that their is a north-south gradient in mean D.O. values with the regions closest to the channel having the highest mean D.O. values and those furthest away from the channel having the lowest mean D.O. values. It is possible that while the coastal exchange does not effect the lagoon over a limited period of study, it may effect it over an extended period.

Since the lagoon produces more carbon than it uses, it may export some of that carbon and thereby increase coastal productivity over an extended period of time. It is also possible that the excess carbon sinks or is actively pulled down to the benthos by filter feeders for benthic consumption.

Increases in dissolved oxygen paralled increases in water temperature and the non-significant trend observed in solar insulation.

Both temperature and salinity distributions indicate that the lagoon is well mixed vertically. Since D.O. is slightly, but significantly higher at the surface, the benthos is probably using oxygen at a higher rate than the rest of the water column. The increased oxygen demand is probably being used to decompose the rich organic sediments (which were frequently noticed on the anchor when it was raised).

The significant variation in relative D.O. values within the water column during the study probably reflect temporal variation in production and respiration.

Since D.O. experienced significant changes in productivity and standing stock, it would be expected that chlorophyll, another indicator of productivity would also experience these changes. Since it did not, the plankton are probably being grazed upon or they are settling to the benthos.

The different mean regional values in wind velocity and direction and the changes in these factors throughout the event are probably responsible for the minimal change in spatial temperature, and the changes in the regional x time temperature parameter. The regional x depth differences in temperature may be caused by a circulation pattern which may change according to wind direction and velocity.

The rise in temperature from 0600 to 1200 is probably due to solar insolation. The high percent of cloud cover and the increased wind velocity is probably responsible for the decline in temperature in early afternoon; nightfall causes this trend to continue until dawn.

The lack of finding a stratified lagoon with respect to temperature or salinity indicates that the lagoon is well mixed vertically. This is not surprising since the lagoon was choppy in late morning and then during the afternoon.

The regional changes in salinity may be due to the regions being effected by differences in solar insulation, which would effect the rates of evaporation. An additional factor could be that the volumes of fresh water intrusion may vary from region to region. The increase in salinity during the day is attributed to increased evaporation from solar insulation and increased wind velocity. The significant change in the regional x time parameter is believed to be caused by the changes in wind velocity and direction during the event.

Using two times secchi disk visibility as an absolutely limiting factor for production (Parsons and Takahashi, 1973), light penetration was only a limiting factor in the deepest holes.

Although the secchi disk did not detect any difference in light intensity during the day, data from percent of cloud cover, and temperature would indicate that there was a trend toward having light intensity increase in the morning, peak in early afternoon, and then decline until dawn. The secchi disk probably failed to notice this difference because it is not a very precise instrument.

In comparison to the diurnal events of Owen on 24 November 1982 and 28 February 1983, this event noticed a different grouping of regions with respect to the three main parameters. Where as this event tended to group regions 1 and 2; station 3 and regions 4 and (5-6); and regions 7 and 8, Owen's studies tended to group regions 1,4, and 7; 3 and 6; and 2 and 5, with region 8 overlapping the two later groups. The difference between this grouping may be due to difference in wind direction and velocity, or the coastal exchange having a different effect on the lagoon during those relative dry seasons. It is of interest to note that during all three events regions 7 and 8 had the lowest D.O. values, and diurnal temperature and D.O. fluctuations were consistently noticed.

LITERATURE CITED

APHA-AWWA-WPCF. 1975. Standard Methods for the Examination of water and wastewater. 14th Ed. American Public Health Association, Washington, D.C. pp. 1031-1032.

Departamento de Recursos Naturales. 1978-79. Estudio de la Laguna Joyuda: un ecosistema marino. Informe Final. pp. 1-3.

García, J.R. 1981. Temporal patterns of the metazoan parasites in the white mullet, Mugil curema Valenciennes from Joyuda Lagoon, Puerto Rico. Master Thesis, Department of Marine Sciences, RUM, Mayaguez, Puerto Rico. pp. 8-9.

Linsley, R.K., M.A. Kohler and J.L.H. Paulhus. 1975. Hydrology for Engineers. McGraw-Hill, New York. p. 119.

Owen, G.P. 1983. Long-term monitoring sampling design. (Unpublished): 1-5.

Parsons, T.R. and M. Takahashi. 1973. Biological oceanographic processes. Pergamon Press. New York. pp. 86.

Pesante, D. 1978. A study of the plankton in Laguna Joyuda, a tropical lagoon on the west coast of Puerto Rico. Master Thesis, Center for Energy and Environment Research. pp. 4-8.

Sokal, R.R. and F.K. Rohlf. 1969. Biometry. W.H. Freeman and Company, San Francisco. pp. 143-355.

APPENDIX

Dissolved Oxygen Measurements (ppm)

Station 0

Time	Depth	1st Reading	2nd Reading
0600	Surface	5.65	5.55
	Bottom	5.75	5.45
0821	Surface	4.8	4.7
	Bottom	-	-
1023	Surface	5.55	5.25
	Bottom	-	-
1200	Surface	6.35	6.3
	Bottom	-	-
1456	Surface	6.5	6.45
	Bottom	6.45	6.5
1652	Surface	6.4	6.4
	Bottom	6.6	6.6
1829	Surface	6.1	6.1
	Bottom	6.2	6.2
2023	Surface	5.6	5.6
	Bottom	5.6	5.6
2252	Surface	5.25	4.85
	Bottom	4.15	4.15
2440	Surface	6.7	6.6
	Bottom	-	-
0309	Surface	6.3	6.1
	Bottom	-	-
0514	Surface	5.83	5.6
	Bottom	5.8	5.55
0717	Surface	6.1	5.9
	Bottom	5.9	5.8
0844	Surface	6.15	6.2
	Bottom	6.25	6.15

Region 1

Time	Depth	1st Reading	2nd Reading
0650	Surface	5.15	5.35
	Bottom	5.45	5.35
0825	Surface	5.7	5.45
	Bottom	5.85	5.45
1029	Surface	6.0	5.9
	Bottom	6.15	6.05
1206	Surface	6.25	6.4
	Bottom	6.1	6.3
1503	Surface	6.8	6.75
	Bottom	6.7	6.75
1703	Surface	6.6	6.5
	Bottom	6.45	6.5
1835	Surface	6.8	6.55
	Bottom	6.1	6.6
2030	Surface	7.0	7.0
	Bottom	6.65	6.9
2300	Surface	6.5	6.4
	Bottom	6.5	6.2
2445	Surface	6.55	6.6
	Bottom	6.55	6.6
0315	Surface	6.3	6.1
	Bottom	6.2	6.15
0523	Surface	5.9	5.95
	Bottom	5.85	5.95
0727	Surface	6.2	6.0
	Bottom	6.1	6.0
0850	Surface	6.05	5.65
	Bottom	4.9	4.45

Region 2

Time	Depth	1st Reading	2nd Reading
0700	Surface	5.45	5.45
	Bottom	5.45	5.55
0830	Surface	5.7	5.65
	Bottom	5.65	5.65
1036	Surface	6.15	6.2
	Bottom	6.45	6.25
1212	Surface	6.55	6.5
	Bottom	6.65	6.65
1513	Surface	6.55	6.5
	Bottom	6.40	6.45
1710	Surface	6.5	6.5
	Bottom	6.1	6.3
1846	Surface	6.7	6.7
	Bottom	6.4	6.5
2039	Surface	6.4	6.2
	Bottom	6.2	6.2
2310	Surface	6.4	6.4
	Bottom	6.2	6.3
2510	Surface	6.5	6.4
	Bottom	6.4	6.3
0325	Surface	6.6	6.6
	Bottom	6.6	6.6
0531	Surface	6.65	6.55
	Bottom	6.55	6.55
0735	Surface	6.25	6.15
	Bottom	6.2	6.15
0859	Surface	6.1	6.1
	Bottom	6.2	6.35

Station 3

Time	Depth	1st Reading	2nd Reading
0710	Surface	5.15	4.95
	Bottom	4.95	5.15
0840	Surface	5.25	5.15
	Bottom	5.45	5.25
1045	Surface	5.65	5.55
	Bottom	6.0	5.65
1224	Surface	6.25	6.25
	Bottom	6.25	6.15
1524	Surface	6.7	6.7
	Bottom	6.7	6.7
1720	Surface	6.7	6.65
	Bottom	6.5	6.5
1856	Surface	6.5	6.3
	Bottom	6.45	6.35
2048	Surface	6.4	6.3
	Bottom	6.3	6.2
2317	Surface	6.35	6.1
	Bottom	6.05	5.95
2515	Surface	5.9	5.8
	Bottom	5.9	5.9
0335	Surface	5.8	5.55
	Bottom	5.6	5.65
0541	Surface	6.15	5.85
	Bottom	5.95	5.85
0743	Surface	5.85	5.7
	Bottom	5.75	5.7
0908	Surface	5.8	5.75
	Bottom	5.75	5.75

Region 4

Time	Depth	1st Reading	2nd Reading
0758	Surface	5.6	5.55
	Bottom	5.35	5.05
1000	Surface	5.7	5.75
	Bottom	5.75	5.75
1140	Surface	5.75	5.65
	Bottom	5.75	5.75
1400	Surface	6.55	6.35
	Bottom	6.2	6.25
1609	Surface	6.6	6.7
	Bottom	6.5	6.6
1804	Surface	6.5	6.4
	Bottom	6.1	6.2
1956	Surface	6.4	6.2
	Bottom	6.2	6.2
2215	Surface	6.1	6.0
	Bottom	6.0	5.95
2415	Surface	6.1	6.0
	Bottom	6.1	6.0
2640	Surface	5.95	5.8
	Bottom	5.85	5.7
0426	Surface	5.95	5.75
	Bottom	5.85	5.9
0637	Surface	6.1	5.9
	Bottom	6.0	6.0
0825	Surface	6.05	5.75
	Bottom	5.55	5.5
1014	Surface	6.2	6.25
	Bottom	6.3	6.25

Region (5-6)

Time	Depth	1st Reading	2nd Reading
0722	Surface	5.15	5.1
	Bottom	5.35	4.95
0920	Surface	5.45	5.45
	Bottom	5.4	5.55
1105	Surface	6.05	5.95
	Bottom	6.15	5.95
1320	Surface	6.45	6.4
	Bottom	6.25	6.5
1535	Surface	6.7	6.7
	Bottom	6.7	6.7
1732	Surface	6.65	6.6
	Bottom	5.55	6.6
1921	Surface	6.6	6.5
	Bottom	6.2	6.35
2134	Surface	6.25	6.05
	Bottom	6.05	5.90
2330	Surface	6.3	6.1
	Bottom	6.1	6.1
2555	Surface	6.2	5.9
	Bottom	6.0	5.8
0350	Surface	5.7	5.6
	Bottom	5.75	5.6
0602	Surface	5.75	5.75
	Bottom	5.65	5.65
0753	Surface	5.75	5.55
	Bottom	5.5	5.55
0934	Surface	6.1	5.95
	Bottom	5.95	5.95

Region 7

Time	Depth	1st Reading	2nd Reading
0745	Surface	4.4	4.25
	Bottom	4.35	4.25
0945	Surface	5.45	4.75
	Bottom	5.25	5.3
1125	Surface	5.15	4.95
	Bottom	5.15	5.0
1348	Surface	6.2	5.95
	Bottom	5.8	5.7
1557	Surface	6.2	6.2
	Bottom	6.1	6.1
1751	Surface	6.2	6.1
	Bottom	5.8	5.85
1945	Surface	6.1	5.9
	Bottom	5.8	5.6
2205	Surface	5.7	5.5
	Bottom	5.5	5.4
2400	Surface	6.1	5.8
	Bottom	5.7	5.6
2620	Surface	5.7	5.4
	Bottom	5.35	5.45
0420	Surface	5.65	5.55
	Bottom	5.65	5.55
0624	Surface	5.1	4.7
	Bottom	4.85	4.7
0813	Surface	5.35	5.15
	Bottom	5.15	4.85
1001	Surface	5.45	5.35
	Bottom	5.4	5.45

Region 8

Time	Depth	1st Reading	2nd Reading
0730	Surface	4.25	3.95
	Bottom	4.45	4.05
0930	Surface	6.05	6.15
	Bottom	6.1	6.15
1115	Surface	5.2	4.95
	Bottom	5.25	5.05
1335	Surface	6.2	6.0
	Bottom	5.95	5.8
1545	Surface	6.3	6.3
	Bottom	6.2	6.2
1742	Surface	6.45	6.25
	Bottom	6.2	6.2
1932	Surface	6.3	6.1
	Bottom	6.0	5.9
2150	Surface	5.5	5.45
	Bottom	5.5	5.5
2350	Surface	5.6	5.3
	Bottom	5.3	5.3
2605	Surface	5.7	5.2
	Bottom	5.4	5.2
0405	Surface	5.35	5.15
	Bottom	5.2	5.05
0613	Surface	5.4	5.3
	Bottom	5.3	5.3
0802	Surface	4.85	4.7
	Bottom	4.55	4.55
0948	Surface	5.25	4.75
	Bottom	4.05	3.85

Temperature Measurements (°C)

Station 0

Time	Depth	1st Reading	2nd Reading
0600	Surface	29	29
	Bottom	29	29
0821	Surface	29	29
	Bottom	-	-
1023	Surface	29	29
	Bottom	-	-
1200	Surface	31	30
	Bottom	-	-
1456	Surface	29	29
	Bottom	29	29
1652	Surface	28.7	28.7
	Bottom	28.7	28.7
1829	Surface	28.2	28.2
	Bottom	28.2	28.2
2023	Surface	28	28
	Bottom	28	28
2252	Surface	28	28
	Bottom	27.5	27.5
2440	Surface	28	28
	Bottom	-	-
0309	Surface	28	28
	Bottom	-	-
0514	Surface	28	28
	Bottom	28	28
0717	Surface	27.8	27.8
	Bottom	27.9	27.9
0844	Surface	28	28
	Bottom	28	28

Region 1

Time	Depth	1st Reading	2nd Reading
0650	Surface	29	29
	Bottom	29	29
0825	Surface	29.5	29.5
	Bottom	29.5	29.5
1029	Surface	29	29.5
	Bottom	29	29.5
1206	Surface	31.5	31.5
	Bottom	31.5	31.5
1503	Surface	29.1	29.1
	Bottom	29.1	29.0
1703	Surface	29	29
	Bottom	29	29
1835	Surface	27	27
	Bottom	29	29
2030	Surface	28.8	28.8
	Bottom	28.9	28.9
2300	Surface	28	28
	Bottom	28	28
2445	Surface	27	28
	Bottom	27	28
0315	Surface	28	28
	Bottom	28	28
0523	Surface	28	28
	Bottom	28	28
0727	Surface	27.8	27.8
	Bottom	27.8	27.8
0850	Surface	28	28
	Bottom	27.5	27.5

Region 2

Time	Depth	1st Reading	2nd Reading
0700	Surface	29	29
	Bottom	29	29
0830	Surface	30	30
	Bottom	30	30
1036	Surface	29.5	29.5
	Bottom	29.5	29.5
1212	Surface	31.5	31.5
	Bottom	31.5	31.5
1513	Surface	29.2	29.2
	Bottom	29.2	29.2
1710	Surface	29.2	29.2
	Bottom	29.2	29.2
1846	Surface	29	29
	Bottom	29	29
2039	Surface	29	29
	Bottom	29	29
2310	Surface	28.5	28.5
	Bottom	28.5	28.5
2510	Surface	28	28.5
	Bottom	28.5	28.5
0325	Surface	28	28
	Bottom	28	28
0531	Surface	27.9	27.9
	Bottom	27.9	27.9
0735	Surface	27.9	28.0
	Bottom	28.0	28.0
0859	Surface	28.1	28.1
	Bottom	28	28

Station 3

Time	Depth	1st Reading	2nd Reading
0710	Surface	29	29
	Bottom	29	29
0840	Surface	30	30
	Bottom	30	30
1045	Surface	29.5	29.5
	Bottom	29.5	30
1224	Surface	31.5	31.5
	Bottom	31.5	31.5
1524	Surface	28.8	28.8
	Bottom	28.8	28.8
1720	Surface	28.8	28.8
	Bottom	28.8	28.8
1856	Surface	28.8	28.8
	Bottom	28.8	28.8
2048	Surface	28.8	28.8
	Bottom	28.8	28.8
2317	Surface	28.5	28.5
	Bottom	28.5	28.5
2515	Surface	28.5	28.5
	Bottom	28.5	28.5
0335	Surface	28	28
	Bottom	28	28
0541	Surface	28	28.1
	Bottom	28	28.2
0743	Surface	28.1	28.1
	Bottom	28.1	28.1
0908	Surface	28.2	28.2
	Bottom	28.2	28.2

Region 4

Time	Depth	1st Reading	2nd Reading
0758	Surface	30	30
	Bottom	29	30
1000	Surface	29.5	29.5
	Bottom	29.5	29.5
1140	Surface	30	30
	Bottom	30	30
1400	Surface	28.8	28.8
	Bottom	28.8	28.8
1609	Surface	29	29
	Bottom	29	29
1804	Surface	28.9	29
	Bottom	29	29
1956	Surface	29	29
	Bottom	29	29
2215	Surface	28.5	28.5
	Bottom	28.5	28.5
2415	Surface	28.5	28.5
	Bottom	28.5	28.5
0240	Surface	28	28.5
	Bottom	28.5	28
0426	Surface	28	28
	Bottom	28	28
0637	Surface	28.1	28.1
	Bottom	28.2	28.2
0825	Surface	28.2	28.2
	Bottom	28.0	28.0
1014	Surface	28.2	28.2
	Bottom	28.2	28.2

Region (5-6)

Time	Depth	1st Reading	2nd Reading
0722	Surface	29.5	29.5
	Bottom	29.5	29.5
0920	Surface	30	30
	Bottom	30	30
1105	Surface	30	30
	Bottom	30	30
1320	Surface	29	29
	Bottom	29	29
1535	Surface	29	29
	Bottom	29	29
1732	Surface	29	28.9
	Bottom	29	28.9
1921	Surface	28.8	28.9
	Bottom	28.8	28.8
2134	Surface	26	26
	Bottom	28.5	28
2330	Surface	28	28.5
	Bottom	28	28.5
2555	Surface	28	28
	Bottom	28	28
0350	Surface	28	28
	Bottom	28	28
0602	Surface	28	28
	Bottom	28	28
0753	Surface	28.1	28.1
	Bottom	28.0	28.0
0934	Surface	28.3	28.3
	Bottom	28.3	28.3

Region 7

Time	Depth	1st Reading	2nd Reading
0745	Surface	29.5	29.5
	Bottom	29.5	30
0945	Surface	29.5	29.5
	Bottom	30	29.5
1125	Surface	30	30
	Bottom	30	30
1348	Surface	29	29
	Bottom	29	29
1557	Surface	29.2	29.2
	Bottom	29.2	29.2
1751	Surface	29	29
	Bottom	29	29
1945	Surface	29	29
	Bottom	29	29
2205	Surface	28.5	28.5
	Bottom	28.5	28.5
0000	Surface	28.5	28.5
	Bottom	28.5	28.5
0220	Surface	28	28
	Bottom	28	28
0420	Surface	28	28
	Bottom	28	28
0624	Surface	28	28
	Bottom	28	28
0813	Surface	28.2	28.2
	Bottom	28.1	28.1
1001	Surface	28	28
	Bottom	28	28

Region 8

Time	Depth	1st Reading	2nd Reading
0730	Surface	30	29.5
	Bottom	30	30
0930	Surface	30	30
	Bottom	30	30
1115	Surface	30.5	30
	Bottom	30	30
1335	Surface	29	29
	Bottom	29	29.1
1545	Surface	29.5	29.4
	Bottom	29.5	29.4
1742	Surface	29.2	29.2
	Bottom	29.2	29.2
1932	Surface	29	29
	Bottom	29	29
2150	Surface	29	29
	Bottom	29	29
2350	Surface	28.5	28.5
	Bottom	28.5	28.5
0205	Surface	28	28.5
	Bottom	28.5	28.5
0405	Surface	28	28
	Bottom	28	28
0613	Surface	28.1	28.2
	Bottom	28.1	28.2
0802	Surface	28.1	28.2
	Bottom	28.2	28.2
0948	Surface	28.5	28.5
	Bottom	28.3	28.2

Salinity Measurements (ppt)

Station 0

Time	Depth	1st Reading	2nd Reading
0600	Surface	26	26
	Bottom	26	26
0821	Surface	25	25
	Bottom	-	-
1023	Surface	25.5	25.5
	Bottom	-	-
1200	Surface	26	26
	Bottom	-	-
1456	Surface	27	27
	Bottom	27	27.1
1652	Surface	33	33
	Bottom	33.2	33.5
1829	Surface	33.2	33.2
	Bottom	33.2	33.2
2023	Surface	33	33
	Bottom	33	33
2252	Surface	29.5	29.5
	Bottom	34	33.5
2440	Surface	28	28
	Bottom	-	-
0309	Surface	27.5	27.5
	Bottom	-	-
0514	Surface	24.2	24.3
	Bottom	24.3	24.3
0717	Surface	26.1	26.2
	Bottom	26.2	26.2
0844	Surface	26.5	26.6
	Bottom	26.5	26.7

Region 1

Time	Depth	1st Reading	2nd Reading
0650	Surface	26	26
	Bottom	26	26
0825	Surface	25.5	25.5
	Bottom	25	25.5
1029	Surface	26	26
	Bottom	26	26
1206	Surface	26.5	26.5
	Bottom	26.5	26.5
1503	Surface	27.1	27.1
	Bottom	27.2	27.2
1703	Surface	27	27.1
	Bottom	27.1	27.1
1835	Surface	27	27
	Bottom	27.5	27.2
2030	Surface	26.8	26.8
	Bottom	26.9	26.9
2300	Surface	28	28
	Bottom	30	28
2445	Surface	28	28
	Bottom	28	28
0315	Surface	27.5	27.5
	Bottom	27.5	27.5
0523	Surface	24.2	24.2
	Bottom	24.2	24.2
0727	Surface	26.2	26.2
	Bottom	26.2	26.2
0850	Surface	26.7	26.8
	Bottom	26.2	26.3

Region 2

Time	Depth	1st Reading	2nd Reading
0700	Surface	26	26
	Bottom	26	26
0830	Surface	25.5	25.5
	Bottom	25.5	25.5
1036	Surface	26	26
	Bottom	26	26
1212	Surface	26	26.5
	Bottom	26	26.5
1513	Surface	27.2	27.2
	Bottom	27.2	27.2
1710	Surface	27.2	27.2
	Bottom	27.2	27.3
1846	Surface	27	27
	Bottom	27	27
2039	Surface	26.9	26.9
	Bottom	26.9	26.9
2310	Surface	28	28
	Bottom	28	28
2510	Surface	28	28
	Bottom	28	28
0325	Surface	27.5	27.5
	Bottom	27.5	27.5
0531	Surface	23.9	23.9
	Bottom	23.9	23.9
0735	Surface	26.2	26.2
	Bottom	26.2	26.2
0859	Surface	26.5	26.6
	Bottom	26.7	26.7

Station 3

Time	Depth	1st Reading	2nd Reading
0710	Surface	26	26
	Bottom	26	26
0840	Surface	25.5	25.5
	Bottom	25.5	25.5
1045	Surface	26	26
	Bottom	26	26
1224	Surface	25.5	25.5
	Bottom	25.5	26
1524	Surface	26.9	26.9
	Bottom	26.9	26.9
1720	Surface	27	27
	Bottom	27	27
1856	Surface	26.9	26.9
	Bottom	26.9	26.9
2048	Surface	26.8	26.8
	Bottom	26.9	26.9
2317	Surface	28	28
	Bottom	28	28
2515	Surface	28	28
	Bottom	28	28
0335	Surface	27	27.5
	Bottom	27	27.5
0541	Surface	23.5	23.5
	Bottom	23.5	23.7
0743	Surface	26.3	26.3
	Bottom	26.2	26.2
0908	Surface	26.5	26.5
	Bottom	26.6	26.6

Region 4

Time	Depth	1st Reading	2nd Reading
0758	Surface	25.5	25.5
	Bottom	25.5	25.5
1000	Surface	26	26
	Bottom	26	26
1140	Surface	25.5	25.5
	Bottom	25.5	25.5
1400	Surface	26.5	26.5
	Bottom	26.5	26.5
1609	Surface	27	27
	Bottom	27	27
1804	Surface	27	27
	Bottom	27	27
1956	Surface	26.9	26.9
	Bottom	26.9	26.9
2215	Surface	28	28
	Bottom	28	28
2415	Surface	27.5	28
	Bottom	28	28
0240	Surface	27.5	27.5
	Bottom	27.5	27.5
0426	Surface	26.5	26.5
	Bottom	27	26.5
0637	Surface	25.2	21.8
	Bottom	23.8	23.2
0825	Surface	26.5	26.5
	Bottom	26.4	26.4
1014	Surface	25.2	21.9
	Bottom	21	22.1

Region (5-6)

Time	Depth	1st Reading	2nd Reading
0722	Surface	26	26
	Bottom	26	26
0920	Surface	25	25.5
	Bottom	25	25
1105	Surface	26	26
	Bottom	26	26
1320	Surface	25.5	27.5
	Bottom	27.5	26.8
1535	Surface	27.0	27.0
	Bottom	27.0	27.0
1732	Surface	27	27.1
	Bottom	27	27.1
1921	Surface	27	26.9
	Bottom	26.8	26.9
2134	Surface	28.5	28.5
	Bottom	28	28
2330	Surface	28	28
	Bottom	28	28
2555	Surface	27.5	27.5
	Bottom	28	27.5
0350	Surface	27	27.5
	Bottom	27	27.5
0602	Surface	23	23.4
	Bottom	23.5	23.5
0753	Surface	26.5	26.3
	Bottom	26.5	26.4
0934	Surface	26.5	26.5
	Bottom	26.5	26.7

Region 7

Time	Depth	1st Reading	2nd Reading
0745	Surface	26	26
	Bottom	26	26
0945	Surface	26.5	26.5
	Bottom	26.5	26.5
1125	Surface	26	26
	Bottom	26	26
1348	Surface	26.8	26.9
	Bottom	26.9	27
1557	Surface	27	27.2
	Bottom	27.2	27.2
1751	Surface	27	27.1
	Bottom	27.2	27.1
1945	Surface	27	27
	Bottom	27	27
2205	Surface	28	28
	Bottom	28	28
0000	Surface	28	28
	Bottom	28	28
0220	Surface	27.5	27.5
	Bottom	27.5	27.5
0420	Surface	27	27
	Bottom	27	27
0624	Surface	24.5	23
	Bottom	23.2	23.2
0813	Surface	26.5	26.5
	Bottom	26.5	26.5
1001	Surface	24	24.2
	Bottom	25	24.2

Region 8

Time	Depth	1st Reading	2nd Reading
0730	Surface	26	26
	Bottom	26	26
0930	Surface	26.5	26.5
	Bottom	26.5	26.5
1115	Surface	25.5	26
	Bottom	25.5	25.5
1335	Surface	27	27.1
	Bottom	27	27.1
1545	Surface	27	27.3
	Bottom	27.2	27.2
1742	Surface	27	27.2
	Bottom	27.2	27.2
1932	Surface	26.9	27.0
	Bottom	27	27
2150	Surface	28	28
	Bottom	28	28
2350	Surface	28	28
	Bottom	28	28
0205	Surface	27.5	27.5
	Bottom	27.5	27.5
0405	Surface	27.5	27.5
	Bottom	27.5	27.5
0613	Surface	25.1	24.8
	Bottom	24.8	24.8
0802	Surface	26.5	26.5
	Bottom	26.5	26.5
0948	Surface	26.8	26.8
	Bottom	26.5	26.5

STATION 0

Time	Wind Velocity (miles/hr)	Wind Direction	Percent Cloud Cover	Secchi Dish Visibility 1st Trial	Secchi Dish Visibility 2nd Trial	Sounding
0600	-	-	-	.55	.55	.55
0821	-	-	-	.5	.5	.5
1023	-	-	-	.55	.55	.55
1200	-	-	-	.5	.5	.5
1456	-	-	-	1.0	1.0	1.1
1652	-	-	-	1.0	1.0	1.2
1829	-	-	-	1.0	1.0	1.0
2023	-	-	-	-	-	1.2
2252	-	-	-	-	-	0.25
2440	-	-	-	-	-	0.5
0309	-	-	-	-	-	1.0
0514	-	-	-	-	-	1.0
0717	-	-	-	-	-	1.0
0844	-	-	-	1.0	1.0	1.0

REGION 1

Time	Wind Velocity (miles/hr)	Wind Direction	Percent Cloud Cover	Secchi Disk Visibility 1st Trial	Secchi Disk Visibility 2nd Trial	Sounding
0650	5	80	15	1.0	1.0	1.0
0825	3	80	15	1.0	1.0	1.0
1029	4	80	45	.75	.75	.75
1206	4	80	35	1.0	1.0	1.0
1503	10	135	90	1.0	1.0	1.25
1703	9	115	90	1.0	1.0	1.2
1835	5.5	125	80	1.0	1.0	1.25
2030	2.5	140	-	-	-	1.3
2300	0	-	-	-	-	0.9
2445	0	-	-	-	-	1.0
0315	0	-	-	-	-	1.4
0523	0	-	10	-	-	1.3
0727	0	-	0	0.9	0.9	1.3
0850	0	-	0	1.2	1.2	1.2

REGION 2

Time	Wind Velocity (miles/hr)	Wind Direction	Percent Cloud Cover	Secchi Disk Visibility 1st Trial	Secchi Disk Visibility 2nd Trial	Sounding
0700	5	80	15	1.25	1.25	1.25
0830	7	120	15	1.0	1.0	1.25
1036	7	110	45	1.0	1.0	1.0
1212	6	110	35	.75	.75	1.25
1513	10	135	80	0.9	0.9	1.6
1710	7.5	110	90	1.0	1.0	1.5
1846	6	130	90	1.0	1.0	1.5
2039	0	-	-	-	-	1.6
2310	0	-	-	-	-	1.1
2510	4.5	135	-	-	-	1.5
0325	4	135	-	-	-	1.5
0531	0	-	10	-	-	1.4
0735	0	0	0	1.0	1.0	1.6
0859	3.5	90	0	1.0	1.0	1.6

STATION 3

Time	Wind Velocity (miles/hr)	Wind Direction	Percent Cloud Cover	Secchi Disk Visibility 1st Trial	Secchi Disk Visibility 2nd Trial	Sounding
0710	5.5	120	15	1.0	1.0	1.0
0840	9	120	20	1.0	1.0	1.0
1045	9.5	120	50	1.0	1.0	1.0
1224	10	130	50	.75	.75	1.0
1524	7	110	90	1.0	1.0	1.25
1720	5	115	80	1.0	1.0	1.4
1856	6	135	-	1.0	1.0	1.0
2048	0	-	-	-	-	0.9
2317	0	-	-	-	-	1.0
2515	4	135	-	-	-	1.0
0335	2	135	-	-	-	0.9
0541	3	95	10	-	-	1
0743	0	-	0	1.0	1.0	1.0
0908	7	90	0	1.0	1.0	1.0

REGION 4

Time	Wind Velocity (miles/hr)	Wind Direction	Percent Cloud Cover	Secchi Disk Visibility 1st Trial	2nd Trial	Sounding
0758	8.5	110	15	1.25	1.25	2.4
1000	8	130	45	1.0	1.0	2.3
1140	10	130	40	1.0	1.0	2.45
1400	9	135	80	1.0	1.0	2.4
1609	6	140	90	1.0	1.0	2.4
1804	8	140	90	1.0	1.0	2.4
1956	5	135	-	-	-	1.9
2215	0	-	-	-	-	3.5
2415	0	-	-	-	-	2.7
0240	2	135	-	-	-	2.4
0426	0	-	-	-	-	2.4
0637	0	-	0	1.0	1.0	2.0
0825	0	-	0	1.2	1.2	2.0
1014	9	125	35	1.0	1.0	2.5

REGION (5-6)

Time	Wind Velocity (miles/hr)	Wind Direction	Percent Cloud Cover	Secchi Disk Visibility 1st Trial	Secchi Disk Visibility 2nd Trial	Sounding
0722	9.5	120	20	1.0	1.0	1.75
0920	10	130	40	1.0	1.0	2.2
1105	8	120	45	1.0	1.0	2.0
1320	10	135	100	1.0	1.0	1.0
1535	8	100	90	1.0	1.0	1.25
1732	9	115	80	.9	.9	.9
1921	5	135	-	-	-	1.25
2134	0	-	-	-	-	2.0
2330	0	-	-	-	-	1.5
2535	0	-	-	-	-	1.6
0350	2.5	135	-	-	-	2
0602	0	-	10	1.0	1.0	2.5
0753	0	-	0	1.0	1.0	1.5
0934	7	120	10	1.2	1.2	1.2

REGION 7

Time	Wind Velocity (miles/hr)	Wind Direction	Percent Cloud Cover	Secchi Disk Visibility 1st Trial	Secchi Disk Visibility 2nd Trial	Sounding
0745	9	110	15	0.75	0.75	1.5
0945	10	130	40	0.75	0.75	1.5
1125	8	110	45	1.0	1.0	1.5
1348	10	150	100	1.0	1.0	1.5
1557	9	135	90	1.0	1.0	1.5
1751	9	150	90	1.0	1.0	1.6
1945	6.5	135	-	-	-	1.6
2205	1	160	-	-	-	1.8
2400	0	-	-	-	-	1.8
0220	0	-	-	-	-	1.7
0420	0	-	-	-	-	1.0
0624	0	-	0	0.8	0.8	1.6
0813	0	-	0	1.0	1.0	1.5
1001	10	135	20	.8	.8	1.8

REGION 8

Time	Wind Velocity (miles/hr)	Wind Direction	Percent Cloud Cover	Secchi Disk Visibility 1st Trial	Secchi Disk Visibility 2nd Trial	Sounding
0730	3.5	160	20	1.0	1.0	1.75
0930	2	160	30	0.75	0.75	1.75
1115	5	160	45	0.75	0.75	1.75
1335	8	150	100	1.0	1.0	1.5
1545	0	0	90	1.0	1.0	1.4
1742	7.5	145	90	1.0	1.0	1.4
1932	4	140	-	-	-	1.5
2150	0	-	-	-	-	1.5
2350	0	-	-	-	-	1.5
0205	0	-	-	-	-	1.5
0405	0	-	-	1.4	1.4	1.4
0613	0	-	-	0.8	0.8	1.4
0802	0	-	0	0.8	0.8	1.3
0948	3.5	120	20	0.8	0.8	1.8

Chlorophyll Data from Station 3 in Joyuda Lagoon

Chlorophyll Concentration (mg/m3)	Time	Date
6.2	0858	7 July 1983
5.25	0858	7 July 1983
6.71	0858	7 July 1983
6.35	0858	7 July 1983
6.42	1051	7 July 1983
5.11	1051	7 July 1983
5.98	1237	7 July 1983
5.69	1237	7 July 1983
5.2	1237	7 July 1983
6.42	1927	7 July 1983
5.55	1927	7 July 1983
5.25	1927	7 July 1983
6.57	1927	7 July 1983
6.2	2107	7 July 1983
5.47	2107	7 July 1983
6.01	2107	7 July 1983
6.57	2107	7 July 1983
5.11	0130	8 July 1983
4.52	0130	8 July 1983
6.71	0555	8 July 1983
5.84	0555	8 July 1983
6.42	0945	8 July 1983
5.84	0945	8 July 1983
6.42	0945	8 July 1983
6.42	0945	8 July 1983

$\bar{x} = 5.97 \pm 0.01$

Flow Data from Station 0 in Joyuda Lagoon
(Unless otherwise indicated flows were taken at 0.6 depth)

Volume (m^3/min)	Complete x-section	Type of Flow	Time	Date
.0032	yes	ebb	0600	7 July 1983
.012				
.032				
.0051				
0				
.023 (0.2 depth)				
.010 (0.8 depth)				
.036	no	ebb	0812	7 July 1983
.054				
1.23	no	ebb	1012	7 July 1983
0.018				
0.036				
1.47	no	ebb	1151	7 July 1983
1.27				
.12	yes	ebb	1420	7 July 1983
.0068				
.020				
.014				
.0024				
.014 (0.2 depth)				
.0096 (0.8 depth)				
.0065	yess	flood	1630	7 July 1983
.23				
.26				
.30				
.17				
.19 (0.2 depth)				
.53 (0.2 depth)				
2.20	no	flood	1820	7 July 1983
3.20				
1.84	no	flood	2025	7 July 1983
1.80				
.012	no	ebb	2240	7 July 1983
.050				

Flow Data (Con't.)

Volume (m^3/min)	Complete x-section	Type of Flow	Time	Date
.14 .072	no		0035	8 July 1983
.526 .018 0.0	no		0300	8 July 1983
.87 .054	no		0455	8 July 1983
.098 .17 .16 .20 .075 .26 (0.2 depth) .26 (0.6 depth)	yes		0712	8 July 1983
1.20 1.34	no		0840	8 July 1983