RIO GRANDE WATER QUALITY BASE LINE STUDY

1974-75

FOR THE RIO GRANDE CANALS AND ASSOCIATED DRAINS FROM SAN MARCIAL, NEW MEXICO TO FORT QUITMAN, TEXAS

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COMPLETION REPORT
Bureau of Reclamation Contract No. 5-07-01-X0185

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The work upon which this publication is based was supported in part by funds provided through the New Mexico Water Resources Research Institute by the United Stated Department of Interior, Bureau of Reclamation.

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Introduction

Purpose

The purpose of this study was to provide a baseline for water quality in the drains, in wastewater return flows, and in the river of the waters of the Rio Grande Project in Texas and New Mexico. In recent years there have been rapid changes in the requirements for water quality that is returned to our nation's rivers and streams. These changes to more restrictive standards have come about because of an increased national concern about the quality of water available for the multiple uses to which it is placed. This has led to a greater interest in water quality on the part of the management agencies of the Rio Grande Project.

The Rio Grande Project reaches from the headwaters of Elephant Butte Reservoir near San Marcial, New Mexico downstream to Ft. Quitman, Texas at the southern end of the irrigated lands. The Project is operated by the Bureau of Reclamation in cooperation with water districts in Texas and New Mexico.

This area, particularly the urban zone in the vicinity of El Paso, Texas and Las Cruces, New Mexico is rapidly developing. Much of the formally irrigated lands is being subdivided into surburban residential housing, into smaller farm-residences, and some of the lands are being used for intensive agricultural and industrial operations. It can be expected that this characteristic of rapid development will continue for some time in the future. There are estimates that the irrigated valleys above and below Las Cruces and El Paso will be heavily populated by the year 2000, and that there will be eight hundred thousand people living on the American side of the Rio Grande in the Project area by that time.

Changes in water use will surely come with the associated land-use modifications. At the present time the majority of the Project water supply is still used for irrigation. Urbanization and industrialization will result in changes in water use, and it should also be anticipated there will be more intensive use of water for both agricultural and other purposes. More intensive use of water and changes in the point and purpose of use can have a marked effect on the quality of water available to downstream uses. The basic purpose of this study is to provide a sound foundation for the evaluation of future changes in quality.

Elements Of The Study

The Rio Grande Baseline Study consisted of a number of different elements: the sampling program, analysis for various constituents, a review of this data, the collection of historical water quality data, technical support of other on-going Bureau of Reclamation water quality programs, and a general review of the water quality data as an indicator for future analytical studies. A brief description of what was involved in each of these elements of studies follows:

(1) Sampling Program

The sampling program had two purposes. The first was the collection of the water samples for subsequent analysis. The second was to provide on-site observation of various points along the river so as to be able to relate the climatic conditions to water quality. It was intended that a relatively large number of different points be sampled at different periods of the year to provide variations in the sources of flows, their volume, and quality.

(2) Laboratory Analysis For Various Constituents

This aspect of the study also had two basic characteristics. One was the selection of traditional parameters so as to be able to compare the data from the baseline study with the historical data available. The second was to include parameters that had not been previously evaluated, or parameters for which there had been no consistent season-to-season evaluation in the past. The selection of these parameters and additions to the list was made in conference with Bureau of Reclamation representatives. (See Appendix A for data).

(3) Survey Data Review

After each sampling run a review of the coliform and COD data was made to check for reasonableness and consistency. These analyses were performed immediately after sampling, and it was relatively easy to collect a check sample if any of the results appeared to be erroneous. This same procedure was followed on the chemical analysis but this was done at a much later date so that it was impractical to collect and run check samples. Another objective of this procedure was to relate physical and climatic conditions to the result of the analysis. This report contains a review of the results of the analysis conducted during the year-long study.

(4) Historical Water Quality Data

Chemical, physical and biological analysis of samples from the waters of the Rio Grande Project have been made over the years by various agencies. The collection and compiling of most of this data in a single place and in a common format involved a significant part of the effort of this Rio Grande Base Line Study. (See Appendix B for data).

(5) Superficial Review of Historical Data

Two of the major benefits of the study are that a new set of comprehensive water quality analysis over a year's period have been made available and that much of the historic data has been compiled in a single source. This data now forms the base from which deviations can be observed. This will also require substrative analysis of the data. This aspect of the study was to test for the existence of relationships that could be used in evaluation of future changes in quality.

(6) Support Of Other Bureau of Reclamation Water Quality Programs

The study staff was called upon on three occasions to contribute to other Bureau concerns related to water quality. Two of these had to do with cattle and feed-lot and dairy operations and involved brief field trips. The other was a brief survey of turbidity and suspended solids content of selected irrigation canals.

(7) Periodic Reports

Quarterly reports on the status of the study were prepared and submitted to the Bureau of Reclamation.

Water Quality Parameters

The samples collected during the study were analyzed for a number of physical, chemical and biological characteristics. All of the routine chemical analysis were performed by the Soil and Water Laboratory of the Agronomy Department at New Mexico State University. Arrangements were made for occassional sample splitting between this laboratory and the NASA White Sands Chemistry Laboratory to provide a quality check. The pesticide screening and analysis were done by the New Mexico State Department of Agriculture State Chemist Laboratory. The coliform, fecal coliform and chemical oxygen demand analysis were run by the study staff in the Civil Engineering Department facilities. This latter group spent two days in Albuquerque, New Mexico in the State Laboratory reviewing procedures and techniques.

The selection of the parameters to be evaluated in the study was made after consultation with the Bureau office staff in El Paso and others concerned with water quality on the Rio Grande in both Texas and New Mexico. The basic concept was to include parameters that would reflect quality and be sufficiently predictable so that variations in concentration or level would be indicators of change. In the subsections that follow, the parameters selected will be arranged into common groups with a brief discussion of the value and significance of each.

Pesticide Analysis

The specifications followed in the sampling, analysis and reporting of pesticide levels is given below:

Water Sample: 1-liter of surface water in a glass bottle with teflon liner in bottle top from each sampling point.

Pre-analysis Procedure: All analysis will be run on filtered (0.45 mp) samples.

Extraction: After filtering, the water sample will be returned to its original container and a hexane extraction performed as described on pages 189-190 of Lamar, et al., "Determination of Organic Insecticides in Water by Electron Capture Gas Chromatography", Organic Pesticides in the Environment, Edited by R.F. Gould, published by Am Chem. Soc., 1966, or using other appropriate techniques for the extraction of chlorinated and phosphorothioate organic pesticides.

Gas Ghromatographic Analysis: Standard election capture gas chromatographic procedures will be used to obtain retention-time plots for the following compounds present in the sample at the indicated levels:

(a) chlorinated hydrocarbons	Level mg/1
heptachlor	0.0001
lindane	0.004
endrin	0.002
methoxychlor	0.05
heptachlor epoxide	0.0001

(b) organophosphates	Level mg/l
ethion	0.02
methyl parathion	0.003
parathion	0.003
malathion	0.003
dizzinon	0.002

Result: The results of the analysis on each sample shall report either a negative indication for a specified pesticide at the level indicated above, or shall report the presence of a material in the sample with a retention time similar to the specified pesticide at a stated concentration level or range of concentrations (confirmation tests are not required).

Dissolved Solids

Samples were analyzed for a number of soluble constituents as measures of the dissolved solids content. These analysis were for calcium, magnesium, sodium, potassium, chlorides, sulfates, carbonates, and bicarbonates. Two other parameters were also included: total dissolved solids (filtrable residue) and electrical conductivity. All of these analysis were carried out to levels indicated in Standard Methods.

Bacteriological Quality

For many years the coliform bacteria has been used as the indicator organism. The membrane filter technique was used to obtain average counts per 100 ml on fecal coliform and coliform in the water samples collected. The level of significance varies with the coliform concentration in the sample.

Organic Contamination

There are a number of parameters that can be used as indicators of the level of organics in water. The chemical oxygen demand test was selected because of its common long-term use and because of its relative reliability over a wide range of concentrations. The test is subject to variations and errors but it remains a reasonably good indicator of the level of organic matter in water.

Nutrients

There has been a great deal of concern in parts of the United States on the fertilization of surface waters by the combined presence of phosphorus and nitrogen in water. These two essential nutrients can lead to excessive algal growths. There have been some reports of limited algal blooms in Elephant Butte reservoir. Analysis were performed at the 0.01 mg/l level as both can influence photosynthetic growth at very low levels of concentration. The presence of these two constituents may be taken as indicators of municipal water pollution, but they may also originate from agricultural runoff.

Trace Metal

A number of trace metals were included because of their importance with respect to health effects. They are also possible indicators of changes in quality due to industrial pollution or agricultural chemicals. The concentration of some of the metal is significantly higher in municipal wastewaters. Metals analyzed for include copper, mercury, zinc, cadmium, arsenic, and lead. The pH of each sample was also measured as the solubility of most metal is highly pH dependent.

Other Parameters

Two other parameters were included because of their general interest. Boron is of concern to agriculture and can be an indicator of certain industrial wastes. LAS is a measure of the presence of synthetic detergents. The test is actually for substances that absorb methylene blue dye and are soluble in an organic such as benzene. Although most synthetic detergents on the market today are biologically degradeable, they could be expected to persist in a stream for a few days.

Sampling Stations and Frequency

Method of Station Selection

The sampling stations were selected after field trips and conferences with representatives of the Bureau of Reclamation, the irrigation districts, the U.S. Geological Survey Mesilla Valley groundwater study and other informed and interested parties. The basic approach to station selection was to include all of the major drains and wastewater discharges and the Rio Grande at selected points above and below reservoirs, diversion dams and points of wastewater inflow. Table I lists these 45 stations and their locations.

Sampling Sequence

Originally the study was to involve only four sample collection periods, each characteristic of a particular season and sequence in the annual irrigation process. The original sampling sequence and reasons for selecting various periods is as follows:

TABLE I

RIO GRANDE WATER QUALITY BASE LINE STUDY - 1975

Sampling Stations	
1	Rio Grande Conveyance Channel at San Marcial
2.	Rio Grande Floodway at San Marcial
3	Elephant Butte Reservoir Near the Dam
4	Rio Grande Just Below Elephant Butte Reservoir
5	T or C Sewage Treatment Plant #1 Effluent Discharge
6	T or C Sewage Treatment Plant Efflent #2(no discharge to river during survey)
7	Rio Grande Below T or C
8	Caballo Reservoir Near the Dam
9	Rio Grande Just Below Caballo
10	Garfield Drain Above Hatch on U.S. 85
11	Hatch Sewage Treatment Plant Effluent at the Plant
12	Hatch Drain Below Hatch
13	Angostura Drain Below Rincon
14	Rio Grande at Hayner Bridge
15	Rincon Drain Near Tonoco
16	Rio Grande Below Leasburg Dam on U.S. 85
17	Selden Drain Near Hill, N.M. on U.S. 85
18	Rio Grande Above Las Cruces on U.S. 80
19	Leasburg Drain Above Las Cruces
20	Las Cruces Sewage Treatment Plant Effluent at the River
21	Picacho Drain Above Mesilla Dam
22	Rio Grande Just Below Mesilla Dam
23	Del Rio Drain Near Vado
24	La Mesa (Chamberino) Drain Near Chamberino
25	Anthony, Texas Sewage Treatment Plant Effluent at the Plant
26	East Drain Near La Tuna
27	Rio Grande Below Anthony
28	Vinten River-Drain Near Canutillo
29	N.Mex. Drain Near State Road 260
30	West Drain Near State Road 260
31	Montoya Drain Near the El Paso Electric Co. Power Plant
32	Rio Grande at El Paso Near the El Paso Electric Co. Power Plant
33	El Paso, Delta Street Sewage Treatment Plant Effluent at the River
34	Franklin Canal at Gauge
35	Rio Grande at Island Station
36	Border Intercept Drain
37	Hudspeth Feeder Canal #1 Near Guadalupe Bridge
38	El Paso, Isleta Sewage Treatment Plant Effluent at the River
39	Tornillo Canal at Alamo Alto
40	Tornillo Drain at Outlet at Alamo Alto
41	Rio Grande at Fort Quitman
42	Fabens Sewage Treatment Plant Effluent at the Plant
43	El Paso Sewage Treatment Plant Above Saragosa Bridge (at the plant)
44	El Paso, Ascarate Sewage Treatment Plant Effluent at the Plant
45	Riverside Canal at its Heading

(a) March 1975 - to represent the early irrigation season when little increase in drain flow is possible.

(b) June 1975 - to represent a period of intensive irrigation and crop growth.

(c) September 1975 - to represent conditions late in the irrigation season when water-use by trees and other vegetation diminishes.

(d) Late December 1975 - to represent the low period in drain return flow and little or no vegetation use.

At the time that the fall (August or September) sampling run was being planned it was decided to enhance the value of the study by including an additional sampling period. Because of the variations in stream flow and water quality that occur during the fall when irrigation is terminated and because water-use by vegetation diminishes, it was considered important to have two sampling runs during this season. Therefore the project activities have been augmented by the addition of another sample run in late October. It was felt that the additional run was justified as the most significant data on return flows may be found during the late fall.

The added collection period proved to be quite valuable as an important hydrologic event occurred at the time of the September collection. This was a series of days when light to heavy rains fell on much of the watershed south of Socorro, New Mexico to Fort Quitman, Texas. As a consequence the Rio Grande received high surface runoff from many of its tributaries that are typically dry. Many of the samples from the main stem of the river reflected this runoff in their turbidity and suspended solids content.

Review of Analytical Results

The results of the chemical and biological analysis performed on the samples taken during the five collection periods are given in Appendix A to this study. The data has been reviewed for apparent accuracy and validity. There are a few obviously questionable entries; for example, for the March run for sample #22 (Rio Grande at Mesilla Dam) the sample bottle used for most metals and the standard cations and anions was contaminated with sulfuric acid, being intended for COD analysis rather than soluble ion analysis.

There are a number of cases where the fecal coliform count exceeds the coliform; this is unlikely to be the actual case, but then you deal with large dilutions in living systems this sort of analytical error is bound to occur. In almost all cases where this reversal is found, the fecal coliform and coliform results are on the same order of magnitude.

When data is not given for a sampling point in the tables in Appendix A, in most cases there was no flow at the time of sampling. At the time of the March run, the Rio Grande at Island Station had not been identified as a sampling point.

As an aid in the evaluation of the analytical results, graphical presentations have been prepared, and some of the more important relationships are reviewed in the subsections that follow. These discussions are grouped by the nature of the sampling point and the constituents. (For graphical plots see Appendix C).

Chemical Oxygen Demand

Figures 1 through 7 are graphs of the COD results of the five sampling periods. The points on these graphs refer to the sampling stations given in Table I. On very turbid samples (the September run was made at a time of high runoff) the COD test was run on settled samples to obtain a more accurate evaluation of the dissolved organic content. Figures 1 and 2 indicate that the COD of samples collected on the Rio Grande above Las Cruces will be less than 100 mg/1 except during periods of high runoff. For this case, settled samples will yield COD values below the 100 mg/1 level. Below Las Cruces, the COD of river samples can exceed 100 mg/1 at times (see Figure 3 for March run) but typically samples from these stations will yield a COD of less than 100 mg/1 (settled samples during periods of high turbidity.

Figure 4 and the lower part of Figure 5 show a similar upper range with a few exceptions. One case in point is the East Drain near La Tuna that was receiving raw sewage from the Town of Anthony at the time of the March run (lower part of Figure 4). Higher COD values can be noted for the drains during periods of runoff (September run), and average dry weather COD of the drains appear to be lower than that of river samples.

The upper part of Figure 5 is for COD in the canals at the lower end of the Rio Grande Project. The average values appear higher than that expected in the drains or the river. This is borne out by the physical appearance of these samples; they are characteristically turbid and colored.

Figures 6 and 7 demonstrate great variability in the COD values for the sewage effluents from the plants sampled. Some plants were consistently high (#11 Hatch, #38 El Paso-Isleta Plant with oxidation ponds) and some consistently low (#5 T or C No. 1 plant, #43 El Paso-Saragosa plant). With a few exceptions all of the results indicated unacceptably high COD values even from the best plants.

A need for improved performance (to obtain COD values of less than 100 mg/l) is evident. A number of the plants were under construction during the survey year and marked improvements were noted when the new plants were put into service (#20 Las Cruces plant, #25 Anthony, Texas plant).

Coliform and Fecal Coliform

Figures 8 through 25 depict the results of analysis for coliform and fecal coliform. A semi-log plot is used (log scale for bacterial numbers and time on an arithmetic scale) because of the wide (multiple-order of magnitude) in variation obtained for the same sampling points or types of sampling points.

A comparison of Figure 8 (coliform) with Figure 9 (fecal coliform) and Figure 10 with Figure 11 and subsequent pairs of figures through 24 and 25 will indicate that when coliform counts are high that fecal coliform are also present in large numbers. Both fecal coliform and coliform increased or decreased proportionately in most cases.

The results for river and reservoir samples are shown on Figures 8 through 13 for these two parameters. Values ranged from zero during some sampling runs for Elephant Butte and Caballo reservoirs and for the river just below these two lakes to half a million at a number of stations on the Rio Grande. The highest values were obtained during the September collection period of high runoff; bacterial levels increased from values on the order of hundreds or less to numbers on the order of a quarter of a million or more. Comparison of the results for the September period of high runoff and the October period of normal conditions shows the marked effect of storm flow on bacterial quality in the Rio Grande. In general, the farther downstream you go, the greater the number of bacteria per 100 ml.

Figures 14 through 19 show similar data for the drains on the Rio Grande Project. As in the case of COD results, the drains are somewhat, but not as greatly influenced by storm runoff as is the water of the Rio Grande. There does not seem to be such a wide variation in bacterial numbers; counts in the lower range are generally much higher in the drains than in the river samples and the higher values for the drains are an order of magnitude lower than the high values for the Rio Grande. Dry weather counts for coliform for many of the drains range from 500 to 5,000. Two drains had relatively high fecal coliform levels: the Hatch drain (#12) and the East Drain near La Tuna (#26). Here again, as was the case with COD data, municipal wastes are the cause of high counts.

Figures 20 and 21 give similar results for the canals at the lower end of the Rio Grande Project. Counts for both coliform and fecal coliform for the canals exceed those in the drains and in the river samples. This coincides with COD data for these different classes of water.

Figures 22, 23, 24, and 25 present data for the region's sewage treatment plants. As with COD data, the Hatch plant (#11) yields the highest counts (hundreds of millions per 100 ml) and the Anthony plant the lowest(after reconstruction). In general, the levels for both coliform and fecal coliform from the treatment plants are extremely high, with only a few plants ever reducing levels below 10,000 coliform and 5,000 fecal coliform per 100 ml. As there are some very serious questions about the chlorination of sewage effluents and as the return flows are used for irrigation of various crops, some of which are eaten raw, additional monitoring for these two parameters appears to be warranted.

Total Dissolved Solids and Conductivity

Figures 26 through 35 give the results of analysis for total dissolved solids and conductivity. Both are measures of the soluble ions in a sample with conductivity not being as precise a parameter as the particular ions present can alter the relationship of conductance to TDS. This is particularly true for the variety of waters that flow into the Rio Grande within the Project bounds because they derive from many sources. An analysis of the ratio of these two parameters for each of the stations sampled would be useful as a check on future quality. A visual comparison of the graphical presentations of conductivity and TDS shows that they vary in similar pattern; for example, compare Figure 26 (upper box) with results for the same sampling stations on Figure 27.

In general, the concentration of TDS and conductivity increases in river samples as you go downstream: compare Figure 26 (upper box) with Figure 30, and Figure 27 (upper box) with Figure 29 (upper box). The TDS and conductivity of drain samples is subject to much less variation over a period of a year than are river samples, but this is not true for drains at the lower end of the Project (see stations #36 and #40 on Figure 31, also compare the lower box on Figure 28 with the upper box). Canal samples show greater variability than does drain quality (Figure 32 versus Figure 31). During periods of high flow the quality improves when gauged by these two parameters.

A distinct seasonal variation can be observed in river and canal samples while TDS and conductivity of flows from most sewage treatment plants (Figures 34 and 35) are relatively free from seasonal changes. There are variations in a few stations that probably could be explained by examination of the source of municipal supply at various times of the year. Ground water infiltration into sewer lines may also be the cause of some of the quality changes that can be noted on Figures 34 and 35.

Common Cations and Anions

Graphical presentation of the data for common cations (calcium, magnesium, sodium and potassium) is given in Figures 36 to 54 and for the common anions (chlorides and sulfates) in Figures 55 to 64. One observation typical of all of the common ions is that a general relationship to TDS and conductivity can be seen in most samples. This relationship is not a consistent one, however.

During periods when there are no releases from Elephant Butte and Caballo reservoirs, concentrations of both anions and cations increase in samples collected from the Rio Grande below these two lakes (see Figures 36 and 40). Quality during low flow is much poorer in terms of soluble constituents than during periods of water release and storm discharge. The seasonal variations in quality become greater in river samples taken at the lower end of the river when compared to those from upstream stations (see Figures 45 and 46 and Figures 61 and 62).

In general, the concentration of anions and cations increases significantly in river samples as you go downstream; for example, the concentration of sodium during periods of water release from Elephant Butte and Caballo reservoirs is typically less than 100 mg/l above Mesilla Dam (Station #22) while below this point values for sodium are characteristically above 100 mg/l (See Figures 45 and 46). These figures tend to indicate that sodium progressively increases. A part of the reason is the concentration of sodium in the drain return flows. Figure 45 (lower box) shows typical values for drains above Las Cruces to be 200 mg/l $\pm$ 50 mg/l, while drains below Mesilla Dam have sodium concentrations above 250 mg/l with some values twice as high (see Figure 47). Sodium concentration in waters at the end of the Rio Grande Project (samples 36, 37, 39 and 40) are very high with values over 500 mg/l not uncommon (Figures 48 and 49).

Nutrients and Surfactants

Nutrients in surface waters become a problem due to excessive algal blooms and the growth of weeds and other vegetation. The presence of unusual or excessive amounts of nutrients may be used as an indicator of pollution, particularly from domestic and municipal sources. This is also true of the presence of surfactants (synthetic detergents).

By and large analysis for detergents (LAS) indicated that only a few sampling stations had unusually high values, and that these were effluents from municipal wastewater treatment plants. A review of the data for LAS given in Appendix A shows that background values in the Rio Grande and its drains are on the order of 0.02 mg/l (there are naturally occurring substances that interfere with the test) while the values for LAS from wastewater plants are above this value. Plants with good biological treatment registered relatively small (but typically above background) amounts of synthetic detergents. The few values that were above the milligram per liter level were from the two plants whose biological treatment units were functioning poorly, if at all.

Figures 65 through 77 in Appendix C give graphical presentations of the nitrate-nitrogen content of samples and the total nitrogen levels. Because of the magnitude of the seasonal variations encountered in both of these parameters, a log scale is used on the vertical axis. This has a tendency to make changes appear much less abrupt than the actual case.

Variations in total nitrogen are not necessarily mirrored in the levels of nitrate-nitrogen that are present. This can be seen by comparing Figures 66 and 73 (lower box): in river samples during periods of high flow (June) there is 1.5 to 3.5 mg/l of total nitrogen (Figure 73) and almost no nitrate-nitrogen (Figure 66), while at low flow conditions (December) the total nitrogen content is on the order of 0.5 to 1.5 mg/l and virtually all of it is in the nitrate form (see Figure 66). At low river flows, water temperature, sunlight, turbidity, velocity of flow, and other environmental factors tend to permit formation of higher percentage concentrations of nitrates relative to total nitrogen. This can be seen in Figures 65, 66 and 67. A similar situation exists in many of the drains, but no generalization can be made (compare Figures 68, 69 and 70)

Even greater variations in the ratio of nitrates to total nitrogen may be observed for sewage treatment plant effluents. There were many effluent samples from treatment plants during the year that yielded total nitrogen values on the order of 20 to 40 mg/l (see Figures 76, lower box and Figure 77). For these same samples, the nitrate-nitrogen levels ranged from 10 to 20 mg/l to values of 0.1 mg/l or less (Figures 71 and 72). These low nitrate concentrations appear to be related to temperature as they occur in the June and September sampling-run results, but there does not seem to be a consistent pattern that holds true for most effluent discharges. It is possible that the low values during September may have been related to the rainfall rather than some biological process change.

Another measure of the nutrient potential of a water is the total phosphorus content as P ; this is also a good indicator of pollution because of the presence of phosphates in synthetic detergents. Figures 78 to 83 depict the total P concentration in the waters sampled. Here again the magnitude of the variations was so great that a log scale was employed. No readily discernible pattern of change was evident for river samples (see Figures 78 and 79), although variations on the order of a factor of ten are not uncommon: concentrations range from 0.01 to 0.4 mg/l at river stations. The drains and the canals (Figures 80, 81 and 82) show similar unrelated variations and levels of phosphorus in the drains, but with higher concentrations in the canals at the lower end of the irrigation system (values up to 6 mg/l). This should not be too surprising as the canals are fed by return flows from the irrigated lands and by some municipal sewage effluent. Phosphates levels in plant discharges are significantly higher, concentrations from 2 to 10 mg/l being common. For these effluents (Figure 83) there is a similar pattern of change at the different plants with P values for the September and December sampling periods typically higher than those during the other three sampling periods.

Irrigation Quality

In addition to coliform and fecal coliform and the various common ions, one other indicator of irrigation water quality was included: Boron. A level of 0.75 mg/l Boron is commonly accepted as the point above which this element may have an adverse effect on crops. In river samples, Boron ranged from about 0.1 to almost 1.0 mg/l (see bottom box on Figures 84 and 85 and Figure 86). Boron values were quite consistent in river samples during periods of water release from Elephant Butte with the levels at downstream stations being slightly higher than those at or near the reservoir (compare bottom box on Figure 84 and Figure 86). There was one unexplainable change in Boron concentrations - Boron values almost doubled in all of the October samples above lower than usual levels in September (period of rainfall and runoff). This same change can be seen for almost all sampling stations including the sewage treatment plants. The overall levels of Boron in the drains and canals are higher than that in river samples (compare Figures 84, 85 and 86 with Figures 87 and 88) The highest levels were obtained in effluent discharges from the regions' sewage treatment plants (Figures 89 and 90) where the maximum values were just slightly greater than 1 mg/1 except in one case when the Boron level at the Hatch treatment plant went to 1.7 mg/1.

Trace Metals

Analyses were run for a number of trace metals as they are indicators of agricultural, industrial, and municipal contamination of surface waters. These elements included copper, mercury, zinc, cadimum, arsenic, and lead. The only sampling points that registered noticeably higher values for these trace nutrients were the municipal wastewater discharges (see Appendix A) and some of the drains and canals at the lower end of the Rio Grande Project irrigation system (Border Intercept Drain, Hudspeth Feeder Canal, and the Tornillo Drain). The highest levels in the drains and canals are for lead and these concentrations could possibly be the result of urban air pollution in the El Paso area. Many of the values for lead in these lower drains and canals exceed the drinking water standard of 0.05 mg/1, and there are one or two analyses that are significantly higher (see Appendix A for stations 37 and 41 for lead).

<u>Cursory Analysis of Historical Data</u>

In addition to compiling the historical data for water quality in the Rio Grande, drains, canals, and effluent discharges some effort was devoted to reviewing this data for possible relationships that could be used as indicators of quality change. The objective of this part of the study was not the development of these relationships but to identify some of the possibilities.

These analyses were made using one of two techniques: selection of typical data and trial graphical plots of this information; and programming of all of the available data for two variables for mathematical modeling to obtain the equation with the best statistical fit.

Graphical Plots

A number of different relationships were investigated by means of graphical displays of portions of the available data. Not all of these plots showed a positive correlation between the variables, but an indication of independence between variable is also of value. Some examples of the plots that appear to be useful in analyzing existing and future water quality data on the Rio Grande system are the following:

(a) Biochemical Oxygen Demand (BOD) at one station versus BOD at a downstream station;

(b) Three-year moving-mean for total dissolved solids (TDS) versus time(at principal river stations);

(c) TDS versus distance downstream;

(d) Flow versus percent sodium at various stations;

(e) Flow versus conductivity at various stations; and

(f) Flow versus TDS for different groups of years to test periods of drought against years of greater runoff.

Mathematical Equations

Some of these same relationships were tested in mathematical equations to find the standard or model equation that offers the best statistical fit of the data. These models are superior to the visual plots because all of the historical data can be used. Table II gives the results of this type of analysis using data from the El Paso sampling station of the International Water and Boundary Commission. The data in Appendix B lends itself to further analytical manipulation and evaluation. The data in Appendix B is available on magnetic tape through the U.S. Bureau of Reclamation.

Conclusions and Recommendations

The Rio Grande Base Line Study has provided a compilation of historical data and a one-year record of water quality for a number of important parameters for the major drains, canals, effluent discharges, and points of interest on the Rio Grande from San Marchial, New Mexico to Fort Quitman, Texas. This body of water quality data should make it possible to identify future changes; this can be done if the data is properly analyzed and existing relationships developed. The further evaluation of the data is warranted and recommended.

TABLE II

MATHEMATICAL CURVE FITTING
OF HISTORICAL DATA FOR THE EL PASO STATIONS
FOR INDICATED IONS
WHERE Y IS THE ION IN MG/L
AND X IS THE FLOW IN THE RIO GRANDE IN CUBIC FEET PER SECOND

Ion (Y)	Equation	Constants A	Constants B	Correlation Coefficient r
Boron	$Y = A + B \ln X$	0.65	- 0.07	0.75
Calcium	$Y = A + B \ln X$	154	- 9.27	0.62
Magnesium	$Y = A X^B$	51.3	- 0.15	0.72
Sodium	$Y = A X^B$	940	- 0.27	0.81
Sulfates	$Y = A + B \ln X$	866	- 89.1	0.81
Chlorides	$Y = A X^B$	884	- 0.29	0.80
Alkalinity	$Y - A + B \ln X$	169	- 9.00	0.56
Nitrates	$Y = A + B \ln X$	2.22	- 0.15	0.10

RIO GRANDE WATER QUALITY BASE LINE STUDY

1974-75

FOR THE RIO GRANDE CANALS AND ASSOCIATED DRAINS

FROM SAN MARCIAL, NEW MEXICO TO FORT QUITMAN, TEXAS

WATER QUALITY STUDY DATA

APPENDIX A

RESULTS FOR RIO GRANDE PROJECT BASE LINE STUDY

MARCH SAMPLING PERIOD

Sample No.	Location	Coliform AVG. Count/100ml	F. Coliform AVG. Count/100ml	C.O.D. mg/1	T.D.S. mg/1	EC mmhos	pH	Ca mg/1	Mg mg/1	Na mg/1
1	Rio Grande Conveyance Channel at San Marcial	105	10	83	648	0.92	7.93	87.8	15.4	107.8
2	Rio Grande Floodway at San Marcial	10,400	35,000	75	460	0.71	8.20	68.1	11.8	77.5
3	Elephant Butte Reservoir at the Dam	0	0	30	424	0.68	8.18	66.5	12.8	72.9
4	Rio Grande below Elephant Butte	10	0	135	444	0.68	8.22	66.5	12.8	72.9
5	T or C Sewage Trtmt. Plant Effluent #1	17.5×10^6	10.9×10^6	131	1,600	2.64	7.39	135.7	17.1	375.0
6	T or C S.T.P. Effluent #2	9.7×10^6	7×10^6	171	916	1.42	7.40	82.0	11.4	193.8
7	Rio Grande below T or C	15,800	7,500	20	412	.69	8.12	66.5	12.8	73.3
8	Caballo Reservoir at Dam	100	20	91	472	.78	8.04	74.0	13.1	83.9
9	Rio Grande below Caballo	83	17	16	492	.78	8.07	73.2	13.0	84.8
10	Garfield Drain above Hatch	4,450	3,100	56	1,232	1.87	7.99	157.9	31.5	243.7
11	Hatch S.T.P. Effluent	17.5×10^6	14.6×10^6	452	668	1.08	7.43	65.5	8.3	165.1
12	Hatch Drain below Hatch	8,100	6,000	133	1,008	1.43	7.85	148.3	22.1	171.0
13	Angostura Drain below Rincon	2,750	1,250	40	1,120	1.79	7.92	144.5	28.1	144.5
14	Rio Grande at Hayner Bridge	600	150	52	480	.80	8.04	76.8	13.0	89.2
15	Rincon Drain near Tonoco Mountain	1,080	1,000	4	1,296	1.83	7.34	170.5	32.1	211.7
16	Rio Grande below Leasburg Dam	500	2,250	56	500	.82	8.03	79.0	13.4	87.1
17	Selden Drain near Hill	----------	--------	---	-----	----	----	----	----	-----
18	Rio Grande above Las Cruces	430	1,280	32	632	.81	7.94	79.8	13.1	88.1
19	Leasburg Drain above Las Cruces	1,490	340	38	756	1.19	7.94	107.6	17.9	135.2

March Sampling Period

Sample No.	K mg/1	Cl mg/1	CO_3 mg/1	HCO_3 mg/1	SO_4 mg/1	NO_3-N mg/1	Total N mg/1	Total P mg/1	Cu mg/1	Hg mg/1	Zn mg/1	Cd mg/1	As mg/1	B mg/1
1	7.8	75.2	7.2	194.0	201.7	0.50	0.69	0.17	<0.10	<.0002	<0.02	<.006	.022	0.21
2	5.9	53.2	4.8	183.1	138.3	0.13	0.69	0.33	<0.10	<.0002	0.03	<.006	.014	0.24
3	5.9	39.7	12.0	159.9	147.9	-0-	2.74	0.03	<0.10	<.0002	0.08	<.006	.008	0.18
4	5.5	53.5	3.6	177.0	163.3	-0-	1.37	0.03	<0.10	.0013	<0.02	<.006	.006	0.18
5	30.5	682.5	-0-	292.9	121.0	4.64	23.33	1.85	<0.10	<.0002	0.02	<.006	.009	0.40
6	19.6	314.1	-0-	250.2	73.0	4.71	7.55	3.13	<0.10	<.0002	0.03	<.006	.006	0.40
7	5.9	54.2	8.4	164.8	146.0	-0-	2.74	0.25	<0.10	<.0002	<0.02	<.006	.004	0.17
8	6.3	86.2	6.0	180.6	134.5	-0-	2.06	0.04	<0.10	<.0002	<0.02	<.006	.002	0.17
9	6.3	85.4	4.8	184.3	140.3	0.02	2.74	0.03	<0.10	<.0002	0.03	<.006	.001	0.17
10	10.6	186.8	6.0	295.3	488.0	-0-	2.74	0.08	<0.10	<.0002	<0.02	<.006	.020	0.35
11	14.5	56.7	-0-	495.5	99.9	0.03	13.03	3.35	<0.10	.0003	0.05	<.006	.003	0.76
12	8.2	129.8	8.4	267.3	363.1	-0-	0.69	0.23	<0.10	.0002	0.02	<.006	.014	0.28
13	9.4	181.2	10.8	308.7	443.8	-0-	0.69	0.04	<0.10	.0003	<0.02	<.006	.017	0.30
14	6.3	94.3	4.8	186.7	138.3	-0-	1.37	0.06	<0.10	<.0002	0.02	<.006	.003	0.18
15	10.2	198.5	13.2	268.5	488.0	0.03	0.69	0.03	<0.10	<.0002	<0.02	<.006	.014	0.33
16	6.3	87.2	8.4	167.2	157.5	-0-	0.69	0.05	<0.10	<.0002	<0.02	<.006	.004	0.18
17	----	----	----	----	----	----	----	----	----	----	----	----	----	----
18	6.3	86.9	7.2	168.4	151.8	0.01	0.69	0.03	<0.10	<.0002	0.02	<.006	.006	0.20
19	7.4	120.5	6.0	227.0	263.2	-0-	-0-	0.04	<0.10	.0005	<0.02	<.006	.008	0.25

March Sampling Period

Sample No.	Location	Coliform AVG. Count/100ml	F. Coliform AVG. Count/100ml	C.O.D. mg/1	T.D.S. mg/1	EC mmhos	pH	Ca mg/1	Mg mg/1	Na mg/1
20	Las Cruces S.T.P. Effluent	26,000	6,000	290	860	1.48	7.32	90.0	21.0	170.6
21	Picacho Drain above Mesilla	2,680	1,020	36	992	1.53	7.98	126.7	23.8	186.0
22	Rio Grande at Mesilla Dam	1,080	120	117	2,964	15.30	1.57	130.3	15.4	101.4
23	Del Rio Drain near Vado	563	100	48	980	1.37	7.94	131.1	21.8	172.4
24	La Mesa Drain near Chamberino	1,060	560	20	1,108	1.62	7.87	154.1	26.9	204.4
25	Anthony, Texas S.T.P. Effluent	22 x 10^6	14.8 x 10^6	245	984	1.60	7.17	46.9	16.7	259.8
26	East Drain near La Tuna	150,000	100,000	161	1,172	1.63	7.84	90.6	21.2	264.6
27	Rio Grande below Anthony	875	182	113	636	.91	7.99	82.0	17.0	102.3
28	Vinton River - Drain near Canutillo	----------	---------	---	------	----	----	----	----	-----
29	N. Mex. Drain near State Road 260	4,230	3,800	28	1,544	2.30	7.99	126.7	29.9	390.4
30	West Drain near State Road 260	2,650	750	40	1,380	2.09	7.96	115.6	31.2	335.0
31	Montoya Drain near the El Paso Electric Co. Power Plant	9,750	1,450	12	1,656	2.43	7.98	114.2	30.8	426.2
32	Rio Grande at El Paso near the El Paso Electric Co. Power Plant	10,100	6,980	125	804	1.20	8.07	94.4	16.8	166.9
33	El Paso City S.T.P. Effluent	36.4 x 10^6	17.8 x 10^6	338	892	1.54	7.28	85.6	13.5	237.9
34	Franklin Canal at Gage	3,500	8,000	169	624	1.02	7.99	85.6	14.6	127.6
35	Rio Grande at Island Station	-----------	---------	---	728	1.07	8.00	85.6	15.2	141.4
36	Border Intercept Drain	-----------	---------	---	------	----	----	----	----	-----
37	Hudspeth Feeder Canal #1 near Guadalupe Bridge	29,500	12,300	109	2,800	3.99	7.79	266.1	56.8	694.1
38	El Paso Oxidation Pond Effluent	1.5 x 10^6	360,000	310	728	1.38	7.33	83.0	10.8	226.7
39	Tornillo Drain at Alamo Alto	11,000	8,300	137	2,716	3.90	8.03	250.9	56.6	678.0
40	Tornillo Drain at Outlet	12,000	4,700	153	2,812	3.93	8.03	262.1	56.5	651.3

March Sampling Period

Sample No.	K mg/l	Cl mg/l	CO_3 mg/l	HCO_3 mg/l	SO_4 mg/l	NO_3-N mg/l	Total N mg/l	Total P mg/l	Cu mg/l	Hg mg/l	Zn mg/l	Cd mg/l	As mg/l	B mg/l
20	18.4	220.5	-0-	378.3	109.5	0.02	6.86	3.10	< 0.10	.0005	0.06	< .006	.003	0.58
21	8.6	163.8	14.4	233.1	370.8	-0-	1.37	0.06	< 0.10	.0005	< 0.02	< .006	.011	0.28
22	7.4	134.7	-0-	-0-	2881.8	0.01	1.37	0.68	< 0.10	.0005	0.08	.007	.002	0.22
23	9.8	145.4	-0-	253.8	313.2	0.11	3.43	0.03	< 0.10	.0005	< 0.02	< .006	.013	0.26
24	11.3	182.9	8.4	228.2	461.1	0.82	1.37	0.06	< 0.10	.0005	< 0.02	< .006	.014	0.27
25	23.9	243.2	-0-	266.0	188.3	14.77	26.75	2.90	< 0.10	.0005	0.03	< .006	.010	0.55
26	17.2	218.4	-0-	284.3	297.8	0.33	2.74	0.40	< 0.10	.0003	< 0.02	< .006	.011	0.33
27	7.0	95.7	-0-	207.5	172.9	0.54	1.37	0.07	< 0.10	.0002	< 0.02	< .006	.006	0.20
28	----	----	----	----	----	----	----	----	----	----	----	----	----	----
29	8.6	276.5	22.8	322.2	561.0	0.02	0.69	0.03	< 0.10	.0002	< 0.02	< .006	.022	0.53
30	10.2	222.6	15.6	322.2	511.1	0.18	1.37	0.03	< 0.10	<.0002	< 0.02	< .006	.022	0.52
31	9.4	302.4	22.8	313.6	555.2	0.13	1.37	0.02	< 0.10	<.0002	< 0.02	< .006	.024	0.58
32	7.8	134.7	10.8	198.9	244.0	0.11	3.43	0.07	< 0.10	<.0002	< 0.02	< .006	.008	0.28
33	12.1	210.2	-0-	347.8	203.7	-0-	1.37	2.68	< 0.10	<.0002	0.05	< .006	.012	0.58
34	7.8	112.7	6.0	197.7	209.4	0.45	4.12	0.15	< 0.10	.0012	< 0.02	< .006	.010	0.22
35	8.2	124.8	6.0	263.6	207.5	-0-	0.69	0.23	< 0.10	.0023	< 0.02	< .006	.012	0.24
36	----	----	----	----	----	----	----	----	----	----	----	----	----	----
37	10.9	780.7	10.8	423.5	864.6	0.46	2.74	0.11	< 0.10	.0003	< 0.02	.007	.034	0.57
38	22.3	185.4	-0-	506.4	55.7	0.42	1.37	2.90	< 0.10	.0011	0.03	< .006	.005	0.70
39	11.7	748.8	19.2	316.1	883.8	0.12	0.69	0.15	< 0.10	.0008	< 0.02	.006	.034	0.55
40	12.1	760.1	-0-	383.2	845.3	0.14	0.69	0.09	< 0.10	.0004	< 0.02	.007	.037	0.53

March Sampling Period

Sample No.	Location	Coliform AVG. Count/100ml	F. Coliform AVG. Count/100ml	C.O.D. mg/1	T.D.S. mg/1	EC mmhos	pH	Ca mg/1	Mg mg/1	Na mg/1
41	Rio Grande at Fort Quitman	160	35	185	6,312	7.71	7.63	430.5	128.4	1,440.5
42	Fabens S.T.P. Effluent	15.4×10^6	4.28×10^6	149	876	1.34	7.57	81.6	16.5	179.1
43	El Paso S.T.P. above Saragosa Bridge Effluent	1.13×10^6	260,000	137	908	1.40	7.33	66.3	16.5	223.9
44	Ascarate, El Paso S.T.P. Effluent	29.2×10^6	15×10^6	217	708	1.26	7.43	65.5	9.1	184.8
45	Riverside Canal at its Heading	485,000	122,000	169	728	1.07	8.00	85.6	15.2	141.4

March Sampling Period

Sample No.	K mg/1	Cl mg/1	CO_3 mg/1	HCO_3 mg/1	SO_4 mg/1	NO_3-N mg/1	Total N mg/1	Total P mg/1	Cu mg/1	Hg mg/1	Zn mg/1	Cd mg/1	As mg/1	B mg/1
41	16.0	2081.4	-0-	572.3	1277.6	-0-	1.37	0.03	< 0.10	.0057	< 0.02	.009	.067	0.97
42	12.5	188.6	-0-	316.1	157.5	11.31	15.10	2.45	< 0.10	< .0002	0.02	< .006	.008	0.32
43	18.0	217.7	-0-	196.5	222.9	12.38	21.96	2.63	< 0.10	.0034	< 0.02	< .006	.101	0.38
44	16.4	168.8	-0-	341.7	107.6	25.27	32.24	2.90	< 0.10	.0005	0.04	< .006	.006	0.33
45	8.7	124.8	6.0	263.6	207.5	-0-	0.69	0.23	< 0.10	-----	< 0.02	< .006	.012	0.24

PESTICIDE ANALYSIS

The Office of the State Chemists reports that for the 41 water samples submitted for this study in March, 1975 that:

There were no pesticide residues found in any of the samples at or above the levels given below for the indicated pesticides:

(a) chlorinated hydrocarbons	Level mg/1
heptachlor	0.0001
lindane	0.004
endrin	0.002
methoxychlor	0.05
heptachlor epoxide	0.0001

(b) organophosphates	Level mg/1
ethion	0.02
methyl parathion	0.003
parathion	0.003
malathion	0.003
dizzinon	0.002

RESULTS FOR RIO GRANDE PROJECT BASE LINE STUDY

JUNE SAMPLING PERIOD

Sample No.	Location	Coliform AVG. Count/100ml	F. Coliform AVG. Count/100ml	C.O.D. mg/l	T.D.S mg/l	EC mmhos	pH	Ca mg/l	Mg mg/l	Na mg/l
1	Rio Grande Conveyance Channell at San Marcial	150	130	20	252	.59	7.97	55.7	10.1	81.6
2	Rio Grande Floodway at San Marcial	14,500	600	37	88	.37	7.90	38.9	6.8	33.1
3	Elephant Butte Reservoir at the Dam	0	0	20	240	.65	8.28	58.5	11.8	80.2
4	Rio Grande below Elephant Butte	45	0	84	308	.70	8.00	62.3	12.8	89.4
5	T or C Sewage Trtmt. Plant Effluent #1	7.8×10^6	1.45×10^6	61	1,440	2.75	7.62	133.7	17.7	402.3
6	T or C S.T.P. Effluent #2	11.9×10^6	1.0×10^6	172	804	1.61	7.85	81.5	12.6	228.3
7	Rio Grande below T or C	40	120	36	348	.72	8.22	64.1	12.7	87.4
8	Caballo Reservoir at Dam	0	0	12	420	.75	8.29	66.7	13.6	91.3
9	Rio Grande below Caballo	210	0	36	412	.76	8.24	68.7	13.7	91.3
10	Garfield Drain above Hatch	2,420	1,000	44	1,156	1.74	8.08	148.1	27.2	234.5
11	Hatch S.T.P. Effluent	4.78×10^6	1.38×10^6	200	492	1.00	7.92	35.3	8.3	170.1
12	Hatch Drain below Hatch	2,530	650	68	1,044	1.64	8.25	136.3	26.0	178.8
13	Angostura Drain below Rincon	2,770	400	28	1,076	1.70	8.01	148.0	26.7	224.1
14	Rio Grande at Hayner Bridge	63	0	36	432	.79	8.26	70.7	14.1	99.3
15	Rincon Drain near Tonoco Mountain	--------	20	24	1,120	1.64	8.13	139.1	27.1	217.0
16	Rio Grande below Leas-burg Dam	140	20	32	488	.80	8.28	70.1	14.0	97.2
17	Selden Drain near Hill	600	10	84	1,016	1.54	8.17	126.6	25.8	209.7
18	Rio Grande above Las Cruces	--------	20	68	452	.81	8.33	70.7	14.5	99.3
19	Leasburg Drain above Las Cruces	453	20	68	732	1.15	8.25	102.6	18.0	133.3

June Sampling Period

Sample No.	K mg/l	Cl mg/l	CO_3 mg/l	HCO_3 mg/l	SO_4 mg/l	NO_3-N mg/l	Total N mg/l	Total P mg/l	Cu mg/l	Hg mg/l	Zn mg/l	Cd mg/l	As mg/l	B mg/l	Pb mg/l	LAS mg/l
1	4.7	36.9	-0-	163.5	124.9	0.14	3.43	0.10	< 0.10	.0014	0.04	< .006	.011	0.16	.007	.025
2	3.9	13.5	-0-	123.2	88.4	0.27	4.12	0.04	< 0.10	.0007	0.13	< .006	.009	0.08	.010	.021
3	5.1	38.5	-0-	180.6	140.2	-0-	2.06	0.06	< 0.10	.0008	< 0.02	< .006	.008	0.16	.003	.011
4	5.5	42.5	-0-	192.8	147.9	0.11	2.74	0.04	< 0.10	.0013	< 0.02	< .006	.010	0.16	.001	.010
5	34.4	704.4	-0-	281.9	117.3	0.03	17.15	1.77	< 0.10	.0016	0.11	< .006	.009	0.40	.007	.057
6	22.3	331.1	-0-	269.7	82.6	1.76	24.70	3.52	< 0.10	.0016	0.17	< .006	.010	0.47	.009	.023
7	5.5	48.9	10.8	170.8	147.9	0.11	2.74	0.06	< 0.10	.0012	< 0.02	< .006	.007	0.18	.002	.011
8	6.2	48.9	8.4	181.8	155.6	-0-	3.43	0.04	< 0.10	.0014	< 0.02	< .006	.006	0.18	.001	.013
9	6.2	47.5	-0-	201.3	157.5	-0-	2.74	0.02	< 0.10	.0016	< 0.02	< .006	.005	0.17	.001	.008
10	12.1	147.5	-0-	366.1	399.6	0.16	2.06	0.02	< 0.10	.0010	< 0.02	< .006	.015	0.32	.006	.006
11	14.5	53.5	-0-	443.0	90.3	0.11	25.38	2.46	< 0.10	.0013	0.24	< .006	.008	0.65	.006	.051
12	8.6	139.0	13.2	288.0	380.4	0.22	2.06	0.10	< 0.10	.0008	< 0.02	< .006	.008	0.31	.005	.013
13	9.0	150.7	-0-	340.5	443.8	0.05	2.74	0.03	< 0.10	.0009	< 0.02	< .006	0.10	0.29	.004	.010
14	6.2	75.5	-0-	208.7	163.3	-0-	2.06	0.12	< 0.10	.0006	0.04	< .006	.005	0.19	.002	.008
15	10.9	157.0	-0-	291.7	457.2	1.22	3.43	0.05	< 0.10	.0010	< 0.02	< .006	.010	0.29	.012	.010
16	6.6	77.6	9.6	186.7	165.2	-0-	1.37	0.04	< 0.10	.0016	< 0.02	< .006	.004	0.20	.006	----
17	9.4	157.0	8.4	311.2	300.0	0.22	4.12	0.02	< 0.10	.0012	< 0.02	< .006	.007	0.28	.008	0.10
18	7.0	88.3	10.8	186.7	174.8	-0-	1.37	0.03	< 0.10	.0009	< 0.02	< .006	.005	0.19	.007	.010
19	7.4	106.7	8.4	219.7	242.0	0.06	1.37	0.03	< 0.10	.0007	< 0.02	< .006	.008	0.21	.007	.011

June Sampling Period

Sample No.	Location	Coliform AVG. Count/100ml	F. Coliform AVG. Count/100ml	C.O.D. mg/1	T.D.S. mg/1	EC mmhos	pH	Ca mg/1	Mg mg/1	Na mg/1
20	Las Cruces S.T.P. Effluent	3.25×10^6	500,000	253	744	1.44	7.85	77.6	18.8	186.9
21	Picacho Drain above Mesilla Dam	93	65	52	976	1.47	8.06	132.9	23.5	184.1
22	Rio Grande at Mesilla Dam	467	97	108	512	.82	8.25	72.1	14.3	97.5
23	Del Rio Drain near Vado	590	20	52	956	1.42	8.27	112.8	22.6	181.4
24	La Mesa Drain near Chamberino	920	35	32	1,172	1.67	8.00	154.1	28.3	207.8
25	Anthony, Texas S.T.P. Effluent	7.5×10^6	3.1×10^6	293	1,000	1.72	7.78	50.1	17.0	309.9
26	East Drain near La Tuna	127,000	28,000	76	1,404	2.22	8.09	114.1	28.3	337.3
27	Rio Grande below Anthony	4,250	1,900	44	668	1.06	8.37	84.4	16.9	139.5
28	Vinton River - Drain near Canutillo	--------	--------	---	-----	----	----	----	----	-----
29	N. Mex. Drain near State Road 260	1,430	40	44	1,496	2.24	8.24	109.2	30.9	352.0
30	West Drain near State Road 260	1,200	400	88	1,544	1.62	8.33	91.2	25.6	246.2
31	Montoya Drain near the El Paso Electric Co. Power Plant	2,650	200	64	1,076	2.02	8.23	118.4	27.8	337.3
32	Rio Grande at El Paso near the El Paso Electric Co. Power Plant	-------	--------	48	1,352	1.16	8.28	85.8	17.1	158.4
33	El Paso City S.T.P. Effluent	3.4×10^6	2.88×10^6	140	712	1.50	7.47	41.7	16.9	234.5
34	Franklin Canal at Gage	1,500	400	88	832	1.12	8.16	83.8	17.1	147.4
35	Rio Grande at Island Station	1,000	--------	24	672	1.88	8.08	133.1	30.6	273.6
36	Border Intercept Drain	17,700	9,330	32	1,208	3.36	7.05	212.0	34.8	610.1
37	Hudspeth Feeder Canal #1 near Guadalupe Bridge	34,000	15,200	44	1,724	2.88	7.93	183.6	39.5	472.2
38	El Paso Oxidation Pond Effluent	405,000	260,000	285	732	1.42	7.88	62.1	12.6	244.1
39	Tornillo Drain at Alamo Alto	6,500	200	32	684	1.21	8.03	79.0	17.0	170.3
40	Tornillo Drain at Outlet	22,700	170	32	2,000	3.05	8.00	183.6	39.6	496.8

June Sampling Period

Sample No.	K mg/1	Cl mg/1	CO_3 mg/1	HCO_3 mg/1	SO_4 mg/1	NO_3-N mg/1	Total N mg/1	Total P mg/1	Cu mg/1	Hg mg/1	Zn mg/1	Cd mg/1	As mg/1	B mg/1	Pb mg/1	LAS mg/1
20	18.7	196.4	-0-	466.2	73.0	0.15	32.34	2.76	< 0.10	.0009	0.15	< .006	.004	0.54	.034	.083
21	9.4	154.2	6.0	256.3	361.2	0.09	4.12	0.06	< 0.10	.0013	0.02	< .006	.010	0.28	.005	.013
22	6.6	56.7	9.6	189.1	172.9	0.06	1.37	0.07	< 0.10	.0015	< 0.02	< .006	.004	0.18	.003	.011
23	9.4	134.7	14.4	257.5	317.0	0.36	3.43	0.04	< 0.10	.0015	< 0.02	< .006	.008	0.24	.005	.011
24	9.4	156.7	-0-	312.4	453.4	0.27	2.06	0.09	< 0.10	.0011	< 0.02	< .006	.009	0.25	.006	.013
25	27.4	207.1	-0-	340.5	198.0	0.09	21.95	3.78	< 0.10	.0006	0.09	< .006	.014	0.51	.047	.115
26	28.5	298.1	-0-	356.3	413.1	0.66	1.37	0.19	< 0.10	.0005	0.04	< .006	.012	0.46	.012	.013
27	9.4	92.9	15.6	207.4	220.9	0.15	3.43	0.07	< 0.10	.0003	< 0.02	< .006	.014	0.22	.005	.010
28	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
29	7.4	260.2	18.0	346.6	518.7	0.33	2.06	0.07	< 0.10	.0004	< 0.02	< .006	.025	0.46	.012	.013
30	8.2	154.6	19.2	275.8	365.0	0.30	3.43	0.03	< 0.10	.0004	0.04	< .006	.023	0.36	.010	.008
31	8.2	276.9	12.0	317.3	441.9	0.24	2.06	0.03	< 0.10	.0004	0.06	< .006	.011	0.48	.011	.011
32	8.6	106.0	12.0	209.9	247.8	0.12	2.74	0.03	< 0.10	.0005	0.05	< .006	.008	0.27	.005	.011
33	16.8	189.7	-0-	250.2	251.7	0.15	22.64	3.32	< 0.10	.0007	0.12	< .006	.007	0.51	.020	.011
34	7.8	100.0	-0-	230.6	236.3	0.09	2.74	0.06	< 0.10	.0005	< 0.02	< .006	.012	0.27	.008	.013
35	9.0	241.4	-0-	386.8	342.0	0.06	4.12	1.20	< 0.10	.0006	< 0.02	< .006	.010	0.43	.007	.024
36	10.9	735.6	-0-	324.6	513.0	1.20	3.43	0.05	< 0.10	.0006	< 0.02	< .006	.025	0.54	.015	.023
37	11.3	477.2	-0-	320.9	518.7	1.64	2.74	0.22	< 0.10	.0004	0.05	< .006	.026	0.44	.026	.011
38	2.3	185.8	-0-	433.2	115.3	0.80	30.87	3.80	< 0.10	.0005	0.06	< .006	.010	0.99	.015	.128
39	10.6	120.2	-0-	249.0	238.2	1.41	4.80	1.08	< 0.10	.0004	0.06	< .006	.013	0.32	.024	.008
40	12.0	498.1	-0-	329.5	551.4	1.98	2.74	0.28	< 0.10	.0004	0.05	< .006	.025	0.44	.020	.014

June Sampling Period

Sample No.	Location	Coliform AVG. Count/100ml	F. Coliform AVG. Count/100ml	C.O.D. mg/1	T.D.S. mg/1	EC mmhos	pH	Ca mg/1	Mg mg/1	Na mg/1
41	Rio Grande at Fort Quitman	360	0	84	4,522	6.64	7.83	337.7	96.9	1156.4
42	Fabens S.T.P. Effluent	3.6×10^6	0.7×10^6	136	744	1.37	7.69	96.4	15.8	174.7
43	El Paso S.T.P. above Saragosa Bridge Effluent	--------	--------	----	-----	----	----	-----	----	------
44	Ascarate, El Paso S.T.P. Effluent	4.9×10^6	0.6×10^6	128	660	1.33	7.67	62.1	13.4	191.0
45	Riverside Canal at its Heading	-------	--------	20	648	1.15	7.91	82.4	17.4	152.6

June Sampling Period

Sample No.	K mg/1	Cl mg/1	CO_3 mg/1	HCO_3 mg/1	SO_4 mg/1	NO_3-N mg/1	Total N mg/1	Total P mg/1	Cu mg/1	Hg mg/1	Zn mg/1	Cd mg/1	As mg/1	B mg/1	Pb mg/1	LAS mg/1
41	15.0	1605.3	-0-	258.7	1123.9	0.03	2.74	0.03	< 0.10	.0005	0.06	< .006	.038	0.79	.029	.014
42	1.2	175.1	-0-	347.8	153.7	0.03	21.27	3.78	< 0.10	.0004	0.10	< .006	.007	0.34	.011	.103
43	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
44	2.0	149.2	-0-	774.6	209.4	0.06	28.81	3.15	< 0.10	.0002	0.15	< .006	.014	0.40	.036	.128
45	8.2	105.3	-0-	230.6	242.1	0.55	6.86	0.14	< 0.10	.0006	0.05	< .006	.014	0.25	.010	.011

PESTICIDE ANALYSIS

The Office of the State Chemists reports that for the 43 water samples submitted for this study in June, 1975 that:

There were no pesticide residues found in any of the samples at or above the levels given below for the indicated pesticides:

(a) chlorinated hydrocarbons	Level mg/1
heptachlor	0.0001
lindane	0.004
endrin	0.002
methoxychlor	0.05
heptachlor epoxide	0.0001

(b) organophosphates	Level mg/1
ethion	0.02
methyl parathion	0.003
parathion	0.003
malathion	0.003
dizzinon	0.002

RESULTS FOR RIO GRANDE PROJECT BASE LINE STUDY

SEPTEMBER SAMPLING PERIOD

Sample No.	Location	Coliform AVG. Count/100ml	F. Coliform AVG. Count/100ml	C.O.D. mg/l	T.D.S. mg/l	EC mmhos	pH	Ca mg/l	Mg mg/l	Na mg/l
1	Rio Grande Conveyance Channel at San Marcial	3,600	22,300	100	564	.76	7.74	75.7	12.1	70.1
2	Rio Grande Floodway at San Marcial	26,000	13,000	402	676	.83	7.58	73.7	12.9	62.3
3	Elephant Butte Reservoir at the Dam	80	13	76	396	.53	7.66	48.3	9.0	52.4
4	Rio Grande below Elephant Butte	3,800	2,320	60	400	.54	7.66	46.5	9.6	53.8
5	T or C Sewage Trtmt. Plant Effluent #1	12.0×10^6	5.3×10^6	148	1,452	2.00	7.08	109.0	14.0	337.3
6	T or C S.T.P. Effluent #2	7.1×10^6	2.5×10^6	180	780	1.20	7.08	72.9	7.9	168.5
7	Rio Grande below T or C	100,000	180,000	112	492	.73	7.60	59.7	7.5	76.3
8	Caballo Reservoir at Dam	560	2,450	72	368	.49	7.71	46.5	7.9	43.2
9	Rio Grande below Caballo	340	1,520	44	440	.61	7.65	50.5	10.0	68.7
10	Garfield Drain above Hatch	80,000	6,450	104	1,080	1.40	7.66	112.2	20.8	168.0
11	Hatch S.T.P. Effluent	16.8×10^6	6.0×10^6	236	888	1.36	7.58	74.7	15.8	192.0
12	Hatch Drain below Hatch	71,000	39,000	92	1,360	1.66	7.62	171.9	26.9	192.0
13	Angostura Drain below Rincon	617	437	104	1,344	1.74	7.74	166.3	30.4	174.9
14	Rio Grande at Hayner Bridge	44,500	250,000	176	348	.52	7.66	55.7	6.8	40.2
15	Rincon Drain near Tonoco Mountain	3,000	2,660	96	1,356	1.76	7.63	156.7	29.4	216.1
16	Rio Grande below Leasburg Dam	35,000	60,000	208	388	.50	7.62	48.3	6.1	44.6
17	Selden Drain near Hill	2,700	1,880	96	1,168	1.50	7.67	123.2	25.0	173.1
18	Rio Grande above Las Cruces	50,000	70,000	368	336	.51	7.63	48.3	7.2	46.0
19	Leasburg Drain above Las Cruces	667	337	88	1,000	1.28	7.89	111.0	21.4	145.5

September Sampling Period

Sample No.	K mg/1	Cl mg/1	CO_3 mg/1	HCO_3 mg/1	SO_4 mg/1	NO_3-N mg/1	Total N mg/1	Total P mg/1	Cu mg/1	Hg mg/1	Zn mg/1	Cd mg/1	As mg/1	B mg/1	Pb mg/1	LAS mg/1
1	7.0	44.0	-0-	179.4	171.0	0.33	0.37	0.15	< 0.10	.0003	0.13	< .006	.015	0.21	.025	.008
2	6.2	36.2	-0-	152.5	224.3	0.44	0.71	0.07	< 0.10	.0005	0.16	< .006	.020	0.20	.021	.007
3	5.1	26.9	-0-	142.8	132.6	0.03	1.04	0.05	< 0.10	.0036	0.13	< .006	.006	0.12	.003	.007
4	5.1	26.2	-0-	155.0	111.4	0.63	1.51	0.10	< 0.10	.0005	0.09	< .006	.006	0.11	.004	.005
5	27.0	571.8	-0-	250.2	104.2	-0-	13.07	3.46	< 0.10	.0015	0.07	< .006	.012	0.31	.006	.017
6	16.4	232.2	-0-	217.2	96.5	3.79	15.52	9.20	< 0.10	.0003	0.09	< .006	.005	0.45	.005	.027
7	7.4	115.6	-0-	157.4	73.0	0.97	1.71	0.21	< 0.10	<.0002	0.09	< .006	.006	0.09	.025	.003
8	5.1	27.3	-0-	147.7	87.9	0.49	3.46	0.13	< 0.10	<.0002	0.03	< .006	.005	0.10	.006	.003
9	5.5	41.8	-0-	197.7	96.5	0.67	1.71	0.11	< 0.10	.0006	0.03	< .006	.007	0.12	.003	.005
10	9.8	128.3	-0-	225.8	371.7	0.35	1.04	0.05	< 0.10	.1690	0.03	< .006	.011	0.25	.008	-0-
11	11.7	93.6	-0-	494.2	173.9	0.32	33.63	9.20	< 0.10	.0003	0.16	< .006	.013	0.77	.031	.042
12	9.8	150.7	-0-	320.9	450.0	0.85	1.65	0.09	< 0.10	.0004	0.03	< .006	.013	0.29	.009	.008
13	9.8	173.0	-0-	330.7	431.3	0.26	0.84	0.11	< 0.10	.0003	0.04	< .006	.008	0.24	.009	.007
14	5.1	29.1	-0-	134.2	108.5	1.07	1.98	0.08	< 0.10	.0003	0.07	< .006	.011	0.10	.044	.005
15	9.0	175.8	-0-	286.8	505.7	0.74	1.37	0.06	< 0.10	.0026	0.04	< .006	.018	0.31	.011	.011
16	3.5	27.3	-0-	139.1	95.1	0.11	0.50	0.14	< 0.10	.0008	0.08	< .006	.011	0.10	.031	.008
17	10.6	163.8	-0-	327.0	287.2	0.91	2.25	0.21	< 0.10	.0005	0.04	< .006	.012	0.24	.010	.008
18	4.7	22.0	-0-	144.0	90.8	1.03	2.18	0.11	< 0.10	.0005	0.08	< .006	.013	0.08	.025	.008
19	8.6	126.5	-0-	284.3	282.4	0.22	1.65	0.04	< 0.10	.0021	0.03	< .006	.006	0.20	.006	.005

September Sampling Period

Sample No.	Location	Coliform AVG. Count/100ml	F. Coliform AVG. Count/100ml	C.O.D. mg/l	T.D.S. mg/l	EC mmhos	pH	Ca mg/l	Mg mg/l	Na mg/l
20	Las Cruces S.T.P. Effluent	2.9×10^6	1.0×10^6	292	876	1.39	7.04	88.8	20.5	159.3
21	Pichacho Drain above Mesilla Dam	1,120	820	144	932	1.26	7.71	104.2	21.0	152.2
22	Rio Grande at Mesilla Dam	140,000	210,000	392	308	.44	7.72	30.5	7.2	52.4
23	Del Rio Drain near Vado	7,100	22,000	88	1,020	1.40	7.78	117.6	21.4	176.3
24	La Mesa Drain near Chamberino	11,000	16,500	48	1,244	1.64	7.79	155.5	26.7	187.8
25	Anthony, Texas S.T.P. Effluent	300,000	200,000	124	1,436	2.14	7.09	64.3	25.2	345.1
26	East Drain near La Tuna	6.13×10^6	4.23×10^6	76	1,772	2.53	7.67	120.2	32.6	456.3
27	Rio Grande below Anthony	610,000	160,000	210	552	.94	7.65	59.3	10.3	121.1
28	Vinton River - Drain near Canutillo	---------	----------	---	-----	----	----	-----	----	-----
29	N. Mex. Drain near State Road 260	4,200	2,500	36	1,600	2.08	7.92	142.9	31.6	315.4
30	West Drain near State Road 260	3,800	2,000	88	1,352	1.80	7.91	117.4	27.0	244.6
31	Montoya Drain near the El Paso Electric Co. Power Plant	8,700	1,200	80	1,352	1.82	7.80	111.4	25.3	267.1
32	Rio Grande at El Paso near the El Paso Electric Co. Power Plant	118,500	110,000	189	596	.92	7.68	65.7	11.4	123.4
33	El Paso City S.T.P. Effluent	23.6×10^6	11.5×10^6	138	808	1.26	7.02	67.9	12.1	197.2
34	Franklin Canal at Gage	140,000	100,000	145	568	.80	7.59	63.5	11.4	95.2
35	Rio Grande at Island Station	140,000	70,000	104	548	.78	7.54	66.3	11.8	98.2
36	Border Intercept Drain	7,130	1,080	92	1,996	2.77	7.45	156.7	29.3	438.6
37	Hudspeth Feeder Canal #1 near Guadalupe Bridge	210,000	61,000	104	2,080	2.74	7.53	156.7	31.5	475.6
38	El Paso Oxidation Pond Effluent	2.85×10^6	0.9×10^6	239	936	1.46	7.32	93.6	11.4	228.3
39	Tornillo Drain at Alamo Alto	---------	27,000	43	1,460	1.97	7.35	110.4	22.4	352.7
40	Tornillo Drain at Outlet	395,000	9,000	35	2,264	2.90	7.48	172.5	31.7	506.2

September Sampling Period

Sample No.	K mg/l	Cl mg/l	CO_3 mg/l	HCO_3 mg/l	SO_4 mg/l	NO_3-N mg/l	Total N mg/l	Total P mg/l	Cu mg/l	Hg mg/l	Zn mg/l	Cd mg/l	As mg/l	B mg/l	Pb mg/l	LAS mg/l
20	14.1	199.6	-0-	307.5	148.9	-0-	25.23	7.25	< 0.10	.0011	0.09	< .006	.006	0.45	.020	.042
21	7.8	119.8	-0-	191.6	371.7	0.41	0.77	0.10	< 0.10	.0016	0.05	< .006	.007	0.19	.006	.013
22	4.7	22.0	-0-	101.3	107.6	0.81	1.38	0.08	< 0.10	.0015	0.07	< .006	.018	0.08	.028	.011
23	10.2	137.5	-0-	291.7	349.7	0.41	2.18	0.08	< 0.10	.0014	0.03	< .006	.021	0.22	.009	.008
24	10.2	165.6	-0-	311.2	427.5	0.60	3.40	0.08	< 0.10	.0017	0.03	< .006	.014	0.21	.011	.095
25	35.2	454.9	-0-	139.1	319.9	-0-	19.86	7.14	< 0.10	.0016	0.09	< .006	.012	0.39	.017	.027
26	24.6	368.0	-0-	385.6	498.1	0.81	1.11	0.11	< 0.10	.0115	0.05	< .006	.026	0.43	.018	.017
27	7.4	72.0	-0-	175.7	208.0	1.05	3.73	0.08	< 0.10	.0017	0.05	< .006	.018	0.17	.041	.025
28	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
29	8.2	242.8	-0-	373.4	498.1	0.65	2.44	0.05	< 0.10	.0013	0.03	< .006	.019	0.39	.012	.023
30	9.4	186.5	-0-	329.5	435.1	0.59	3.19	0.05	< 0.10	.0013	0.05	< .006	.021	0.37	.012	.018
31	8.6	206.0	-0-	328.3	438.5	0.56	2.32	0.05	< 0.10	.0010	0.05	< .006	.020	0.36	.016	.008
32	6.6	69.1	-0-	173.3	208.0	0.97	3.19	0.10	< 0.10	.0032	0.09	< .006	.014	0.14	.050	.007
33	10.2	151.0	-0-	250.2	252.6	-0-	20.53	6.26	< 0.10	.0096	0.12	< .006	.005	0.38	.020	.074
34	6.6	65.9	-0-	151.3	211.8	0.97	1.58	0.13	< 0.10	.0017	0.05	< .006	.015	0.13	.047	.008
35	7.0	63.5	-0-	165.0	196.9	1.13	2.32	0.14	< 0.10	.0057	0.11	< .006	.019	0.14	.048	.011
36	10.6	553.1	-0-	281.9	483.2	2.01	2.86	0.48	< 0.10	.0027	0.03	< .006	.026	0.39	.012	.025
37	9.4	479.7	-0-	290.4	557.6	2.01	2.44	0.25	< 0.10	.0014	0.07	< .006	.029	0.37	.090	.029
38	17.2	195.0	-0-	472.3	156.1	0.05	20.66	10.90	< 0.10	.0016	0.05	< .006	.012	0.77	.014	.058
39	10.2	324.7	-0-	242.8	420.3	2.13	3.86	0.57	< 0.10	.0015	0.12	< .006	.030	0.29	.056	.033
40	11.7	627.9	-0-	306.3	498.1	1.73	3.06	0.50	< 0.10	.0015	0.04	< .006	.024	0.36	.025	.027

September Sampling Period

Sample No.	Location	Coliform AVG. Count/100ml	F. Coliform AVG. Count/100ml	C.O.D. mg/l	T.D.S. mg/l	EC mmhos	pH	Ca mg/l	Mg mg/l	Na mg/l
41	Rio Grande at Fort Quitman	250,000	730,000	112	1,096	1.52	7.46	91.8	18.1	215.1
42	Fabens S.T.P. Effluent	25.5×10^6	2.5×10^6	145	880	1.29	6.93	76.3	17.0	170.8
43	El Paso S.T.P. above Saragosa Bridge Effluent	80,000	36,700	92	1,040	1.37	6.97	33.5	17.1	199.8
44	Ascarate, El Paso S.T.P. Effluent	48.3×10^6	32.8×10^6	116	764	1.29	7.09	66.9	10.4	194.5
45	Riverside Canal at its Heading	180,000	25,000	22	648	.80	7.49	49.3	11.9	99.5

September Sampling Period

Sample No.	K mg/l	Cl mg/l	CO_3 mg/l	HCO_3 mg/l	SO_4 mg/l	NO_3-N mg/l	Total N mg/l	Total P mg/l	Cu mg/l	Hg mg/l	Zn mg/l	Cd mg/l	As mg/l	B mg/l	Pb mg/l	LAS mg/l
41	7.4	215.2	-0-	250.2	254.1	1.42	2.79	0.30	< 0.10	.0020	0.37	< .006	.080	0.25	.188	.035
42	10.2	184.3	-0-	273.3	156.1	10.50	12.53	5.91	< 0.10	.0014	0.14	< .006	.011	0.30	.012	.095
43	14.8	205.3	-0-	133.0	200.8	18.98	36.20	7.85	< 0.10	.0012	0.04	< .006	.008	0.28	.008	.116
44	16.0	152.4	-0-	319.7	171.0	0.07	37.13	8.75	< 0.10	.0006	0.12	< .006	.004	0.31	.022	.137
45	6.6	63.1	-0-	161.1	173.9	0.36	1.38	0.15	< 0.10	.0007	0.07	< .006	.014	0.14	.028	.029

PESTICIDE ANALYSIS

The Office of the State Chemists reports that for the 44 water samples submitted for this study in September, 1975 that:

There were no pesticide residues found in any of the samples at or above the levels given below for the indicated pesticides:

(a) chlorinated hydrocarbons	Level mg/l
heptachlor	0.0001
lindane	0.004
endrin	0.002
methoxychlor	0.05
heptachlor epoxide	0.0001

(b) organophosphates	Level mg/l
ethion	0.02
methyl parathion	0.003
parathion	0.003
malathion	0.003
dizzinon	0.002

RESULTS FOR RIO GRANDE PROJECT BASE LINE STUDY

OCTOBER SAMPLING PERIOD

Sample No.	Location	Coliform A.V.G. Count/100ml	F. Coliform AVG. Count/100ml	C.O.D. mg/1	T.D.S. mg/1	EC mmhos	pH	Ca mg/1	Mg mg/1	Na mg/1
1	Rio Grande Conveyance Channel at San Marcial	3,800	1,730	35	624	.92	7.96	87.4	15.2	102.1
2	Rio Grande Floodway at San Marcial	-----------	------------	---	-------	----	----	-----	----	----
3	Elephant Butte Reservoir At the Dam	-----------	-------------	23	376	.60	7.91	56.1	10.6	57.7
4	Rio Grande below Elephant Butte	100	30	118	388	.61	8.19	56.9	10.3	53.9
5	T or C Sewage Trtmt. Plant Effluent #1	25.5×10^6	3.47×10^6	158	1,128	1.94	7.00	101.8	13.8	319.3
6	T or C. S.T.P. Effluent #2	22.5×10^6	1.55×10^6	340	832	1.36	7.00	76.6	11.2	205.7
7	Rio Grande Below T or C	76,000	2,000	27	1,520	2.07	7.92	127.4	19.9	291.0
8	Caballo Reservoir at Dam	40	20	27	368	.48	8.05	49.5	8.1	47.6
9	Rio Grande below Caballo	600	67	87	496	.79	8.16	66.3	14.8	91.9
10	Garfield Drain above Hatch	800	4,180	63	1,304	1.83	7.94	150.7	28.6	235.9
11	Hatch S.T.P. Effluent	130×10^6	16.3×10^6	422	712	1.12	7.14	86.6	11.4	166.9
12	Hatch Drain below Hatch	450,000	11,900	39	1,208	1.72	7.66	168.3	26.5	184.6
13	Angostura Drain below Rincon	770	200	39	1,200	1.70	7.71	158.9	24,9	205.1
14	Rio Grande at Hayner Bridge	9,500	1,500	39	1,204	1.48	7.67	130.9	24.5	156.6
15	Rincon Drain near Tonoco Mountain	3,050	1,340	27	1,916	2.33	7.81	204.2	37.8	277.5
16	Rio Grande below Leasburg Dam	43	57	31	1,096	1.60	7.73	139.5	24.9	160.0
17	Selden Drain near Hill	780	292	27	1,188	1.74	7.89	151.7	26.2	207.8
18	Rio Grande above Las Cruces	370	168	31	1,156	1.63	7.87	130.7	26.5	185.7
19	Leasburg Drain above Las Cruces	285	300	31	1,004	1.40	7.94	130.9	21.9	162.1

October Sampling Period

Sample No.	K mg/l	Cl mg/l	CO_3 mg/l	HCO_3 mg/l	SO_4 mg/l	NO_3-N mg/l	Total N mg/l	Total P mg/l	Cu mg/l	Hg mg/l	Zn mg/l	Cd mg/l	As mg/l	B mg/l	Pb mg/l	LAS mg/l
1	7.4	65.9	-0-	224.5	200.8	0.29	0.47	0.19	0.16	.0006	< 0.02	< .006	.005	0.33	.007	.020
2	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
3	5.9	27.6	-0-	148.9	139.8	0.40	0.81	0.04	< 0.10	.0006	< 0.02	< .006	.004	0.28	.003	.016
4	5.9	28.0	-0-	145.2	142.6	0.24	1.48	0.08	< 0.10	.0004	< 0.02	< .006	.005	0.28	.003	.016
5	25.0	406.3	-0-	464.9	127.8	0.05	22.51	2.75	0.16	.0004	0.03	< .006	.003	0.57	.012	.053
6	20.3	254.4	-0-	294.1	90.8	1.50	33.60	4.42	0.14	.0002	0.06	< .006	.002	1.73	.013	9.470
7	18.0	467.3	-0-	192.8	168.1	0.43	1.01	0.30	< 0.10	.0002	< 0.02	< .006	.008	0.42	.016	.055
8	6.6	30.1	-0-	150.1	93.7	0.49	3.36	0.06	< 0.10	.0003	< 0.02	< .006	.006	0.27	.004	.023
9	5.1	54.9	-0-	252.6	126.3	0.02	0.20	0.01	< 0.10	.0004	< 0.02	< .006	.004	0.32	.004	.013
10	11.7	153.9	-0-	350.2	490.9	0.31	2.15	0.01	0.11	.0004	< 0.02	< .006	.003	0.45	.018	.013
11	14.8	53.9	-0-	521.7	96.5	0.78	35.15	4.90	0.18	.0002	0.05	< .006	.002	0.87	.025	8.020
12	10.9	143.2	-0-	313.6	438.5	1.20	1.75	0.32	< 0.10	.0002	< 0.02	< .006	.004	0.48	.018	.025
13	10.6	153.5	-0-	270.9	453.4	0.09	0.60	0.05	< 0.10	.0002	< 0.02	< .006	.003	0.44	.012	.018
14	10.2	131.2	-0-	252.6	351.1	0.47	1.28	0.12	< 0.10	.0002	< 0.02	< .006	.004	0.40	.012	.013
15	16.0	241.4	-0-	303.9	617.2	0.35	1.34	0.03	< 0.10	.0002	< 0.02	< .006	.004	0.57	.025	.011
16	11.3	158.1	-0-	242.8	380.9	0.25	0.54	0.03	< 0.10	.0004	< 0.02	< .006	.004	0.42	.022	.011
17	11.7	178.0	-0-	320.9	386.6	0.47	1.68	0.08	< 0.10	.0002	< 0.02	< .006	.005	0.43	.011	.011
18	12.1	168.0	-0-	284.3	347.7	0.21	0.94	0.02	< 0.10	.0002	< 0.02	< .006	.003	0.42	.012	.011
19	9.4	126.9	-0-	273.3	338.1	0.26	1.48	0.04	< 0.10	.0002	< 0.02	< .006	.003	0.38	.010	.011

October Sampling Period

Sample No.	Location	Coliform AVG. Count/100ml	F. Coliform AVG. Count/100ml	C.O.D. mg/1	T.D.S. mg/1	EC mmhos	pH	Ca mg/1	Mg mg/1	Na mg/1
20	Las Cruces S.T.P. Effluent	6.0×10^6	660,000	213	780	1.31	7.13	73.5	18.1	158.8
21	Picacho Drain above Mesilla Dam	1,800	1,250	43	1,368	1.69	7.90	141.1	26.2	203.2
22	Rio Grande at Mesilla Dam	7,000	290	39	1,344	1.61	7.99	139.5	26.0	191.5
23	Del Rio Drain near Vado	1,000	2,060	35	1,144	1.48	7.97	133.7	23.3	201.8
24	La Mesa Drain near Chamberino	2,100	800	31	1,588	2.17	7.91	210.4	35.5	267.8
25	Anthony, Texas S.T.P. Effluent	750,000	500,000	55	1,244	1.67	7.31	49.3	17.4	284.1
26	East Drain near La Tuna	7,000	6,200	51	2,332	3.35	8.25	139.1	41.1	568.3
27	Rio Grande below Anthony	310	300	94	1,376	1.73	8.19	152.1	27.7	200.5
28	Vinton River - Drain near Canutillo	---------	---------	---	-----	----	----	-----	----	-----
29	N. Mex. Drain near State Road 260	547	1,260	47	2,000	2.38	8.12	142.7	33.4	348.3
30	West Drain near State Road 260	360	158	67	1,752	2.30	7.93	139.7	36.8	361.2
31	Montoya Drain near the El Paso Electric Co. Power Plant	1,600	707	55	1,776	2.50	8.14	89.2	36.2	422.3
32	Rio Grande at El Paso near the El Paso Electric Co. Power Plant	110	340	43	1,516	2.20	8.19	160.9	36.7	306.4
33	El Paso City S.T.P. Effluent	9,000	4,600	166	928	1.61	7.10	39.1	15.9	251.5
34	Franklin Canal at Gage	900	600	39	1,540	2.15	8.28	153.3	31.6	288.1
35	Rio Grande at Island Station	540,000	16,000	63	1,588	2.02	7.26	134.9	29.5	266.2
36	Border Intercept Drain	2,850	2,050	47	4,116	5.53	7.85	307.4	53.5	924.6
37	Hudspeth Feeder Canal #1 near Guadalupe Bridge	250,000	46,000	79	3,052	3.26	7.73	214.6	46.7	536.6
38	El Paso Oxidation Pond Effluent	1.13×10^6	535,000	181	740	1.53	7.03	82.1	8.3	235.2
39	Tornillo Drain at Alamo Alto	87,000	483	71	1,312	2.10	7.18	109.2	24.7	305.1
40	Tornillo Drain at Outlet	38,000	1,150	39	3,188	5.13	7.70	346.1	58.3	851.8

October Sampling Period

Sample No.	K mg/1	Cl mg/1	CO_3 mg/1	HCO_3 mg/1	SO_4 mg/1	NO_3-N mg/1	Total N mg/1	Total P mg/1	Cu mg/1	Hg mg/1	Zn mg/1	Cd mg/1	As mg/1	B mg/1	Pb mg/1	LAS mg/1
20	21.9	176.9	-0-	297.8	153.2	0.05	13.57	4.42	< 0.10	.0002	< 0.02	< .006	.009	0.67	.003	.360
21	9.8	163.8	-0-	290.4	423.6	0.32	0.67	0.01	< 0.10	.0004	< 0.02	< .006	.005	0.40	.001	.020
22	10.9	169.8	-0-	294.1	408.7	0.63	1.34	0.19	0.14	.0002	< 0.02	< .006	.004	0.42	.011	.018
23	9.4	150.3	-0-	302.6	386.6	0.76	2.75	0.06	0.13	.0002	< 0.02	< .006	.003	0.41	.012	.009
24	9.4	219.1	-0-	358.8	398.5	0.86	2.82	0.06	0.13	.0002	< 0.02	< .006	.004	0.43	.018	.011
25	30.5	344.6	-0-	129.3	245.4	16.31	21.04	3.21	< 0.10	.0004	0.05	< .006	.007	0.54	.019	.036
26	42.2	506.3	16.8	428.3	654.2	1.15	1.55	0.33	0.11	.0004	< 0.02	< .006	.009	0.77	.042	.011
27	10.9	175.5	13.2	262.4	427.5	0.55	3.56	0.10	0.10	.0002	< 0.02	< .006	.010	0.41	.013	.013
28	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
29	9.8	279.4	-0-	338.0	553.8	0.36	2.08	0.02	< 0.10	.0002	0.02	< .006	.009	0.57	.018	.009
30	10.9	234.0	-0-	427.1	564.8	0.58	3.36	0.01	< 0.10	.0002	< 0.02	< .006	.008	0.62	.020	.009
31	10.6	285.4	-0-	340.5	606.1	0.54	2.02	0.01	< 0.10	.0007	< 0.02	< .006	.008	0.63	.025	.011
32	11.3	249.6	-0-	363.7	509.1	0.43	2.69	0.06	< 0.10	.0002	< 0.02	< .006	.006	0.51	.023	.013
33	17.2	203.5	-0-	178.2	264.2	0.09	24.26	3.06	< 0.10	.0004	0.07	< .006	.005	0.67	.021	.219
34	12.5	240.7	13.2	297.8	513.0	0.49	2.42	0.14	< 0.10	.0002	< 0.02	< .006	.006	0.51	.018	.016
35	12.9	256.0	-0-	333.1	367.9	0.65	3.23	2.70	< 0.10	.0005	< 0.02	< .006	.007	0.75	.015	.123
36	12.5	941.3	-0-	377.1	773.3	0.56	3.36	0.22	< 0.10	.0007	< 0.02	< .006	.020	0.63	.078	.075
37	13.3	601.3	27.0	314.2	676.7	2.07	2.76	0.41	< 0.10	.0007	0.02	< .006	.012	0.83	.026	.038
38	21.9	198.2	-0-	491.2	75.9	0.25	29.03	2.89	0.14	.0007	0.06	< .006	.002	0.58	.013	.147
39	14.1	271.2	-0-	262.4	405.4	0.97	1.28	1.78	< 0.10	.0005	< 0.02	< .006	.005	0.48	.014	.123
40	14.1	1091.6	-0-	417.3	810.3	1.95	3.36	0.39	< 0.10	.0007	< 0.02	< .006	.012	0.67	.065	.048

October Sampling Period

Sample No.	Location	Coliform AVG. Count/100ml	F. Coliform AVG. Count/100ml	C.O.D. mg/1	T.D.S. mg/1	ED mmhos	pH	Ca mg/1	Mg mg/1	Na mg/1
41	Rio Grande at Fort Quitman	1,500	800	51	3,616	5.27	7.99	282.6	56.7	965.3
42	Fabens S.T.P. Effluent	21.5×10^6	3.0×10^6	83	868	1.44	7.20	92.2	18.5	199.8
43	El Paso S.T.P. above Saragosa Bridge Effluent	380,000	600	79	1,048	1.76	7.08	89.6	20.9	270.6
44	Ascarate, El Paso S.T.P. Effluent	4.0×10^6	1×10^6	206	632	1.34	7.15	29.5	9.6	201.2
45	Riverside Canal at its Heading	255,000	12,500	67	1,296	2.04	7.09	118.4	27.1	316.1

October Sampling Period

Sample No.	K mg/l	Cl mg/l	CO_3 mg/l	HCO_3 mg/l	SO_4 mg/l	NO_3-N mg/l	Total N mg/l	Total P mg/l	Cu mg/l	Hg mg/l	Zn mg/l	Cd mg/l	As mg/l	B mg/l	Pb mg/l	LAS mg/l
41	16.0	1101.2	-0-	369.1	996.1	1.87	2.76	0.36	< 0.10	.0005	0.04	< .006	.008	0.63	.061	.032
42	10.6	216.6	-0-	302.6	181.5	24.02	30.67	2.49	< 0.10	.0007	0.02	< .006	.003	0.30	.009	.191
43	17.6	246.4	-0-	325.8	281.0	12.80	33.82	2.00	< 0.10	.0004	0.03	< .006	.003	0.34	.014	.109
44	17.6	154.9	-0-	261.1	145.5	14.03	31.52	3.17	< 0.10	.0005	0.06	< .006	.003	0.38	.037	.810
45	14.5	240.4	-0-	536.3	422.2	0.47	2.69	3.02	< 0.10	.0005	0.04	< .006	.003	0.48	.021	.085

PESTICIDE ANALYSIS

The Office of the State Chemists reports that for the 43 water samples submitted for this study in October, 1975 that:

There were no pesticide residues found in any of the samples at or above the levels given below for the indicated pesticides:

(a) chlorinated hydrocarbons	Level mg/l
heptachlor	0.0001
lindane	0.004
endrin	0.002
methoxychlor	0.05
heptachlor epoxide	0.0001

(b) organophosphates	Level mg/l
ethion	0.02
methyl parathion	0.003
parathion	0.003
malathion	0.003
dizzinon	0.002

RESULTS FOR RIO GRANDE PROJECT BASE LINE STUDY

DECEMBER SAMPLING PERIOD

Sample No.	Location	Coliform AVG. Count/100ml	F. Coliform AVG. Count/100ml	C.O.D. mg/1	T.D.S. mg/1	EC mmhos	pH	Ca mg/1	Mg mg/1	Na mg/1
1	Rio Grande Conveyance Channel at San Marcial	39,500	10,200	34	372	.53	7.46	52.3	8.9	52.4
2	Rio Grande Floodway at San Marcial	----------	----------	---	------	-----	----	-----	----	-----
3	Elephant Butte Reservoir At the Dam	13	400	24	432	.64	7.77	59.3	11.1	61.1
4	Rio Grande below Elephant Butte	5	0	22	460	.67	7.81	59.5	11.7	73.6
5	T or C Sewage Trtmt. Plant Effluent #1	10.5×10^6	800,000	147	1,304	2.07	7.01	113.6	16.9	317.0
6	T or C S.T.P. Effluent #2	450,000	600,000	223	844	1.40	7.20	81.2	12.8	181.6
7	Rio Grande Below T or C	8,500	4,000	50	1,252	1.80	7.75	121.8	20.9	231.0
8	Caballo Reservoir at Dam	1,090	380	40	484	.59	8.02	59.9	9.7	61.8
9	Rio Grande below Caballo	1,400	200	28	636	.86	7.98	59.1	9.7	132.6
10	Garfield Drain above Hatch	1,620	2,000	70	1,564	1.83	7.81	172.7	32.6	229.9
11	Hatch S.T.P. Effluent	28.8×10^6	28.8×10^6	441	772	1.08	7.20	31.5	8.8	192.9
12	Hatch Drain below Hatch	24,200	2,200	34	1,236	1.67	7.61	168.1	27.6	186.0
13	Angostura Drain below Rincon	200	120	74	1,216	1.53	7.58	145.5	24.9	220.9
14	Rio Grande at Hayner Bridge	23	0	30	1,116	1.61	7.61	144.5	28.7	196.5
15	Rincon Drain near Tonoco Mountain	725	800	46	1,620	2.02	7.87	189.6	37.7	241.4
16	Rio Grande below Leasburg Dam	490	350	28	1,312	1.74	8.01	144.3	30.0	195.9
17	Selden Drain near Hill	1,425	200	46	1,312	1.61	7.79	143.1	29.9	201.4
18	Rio Grande above Las Cruces	243	700	38	1,324	1.64	7.77	140.9	29.8	200.0
19	Leasburg Drain above Las Cruces	750	380	38	976	1.38	8.02	121.0	21.3	171.5

December Sampling Period

Sample No.	K mg/1	Cl mg/1	CO_3 mg/1	HCO_3 mg/1	SO_4 mg/1	NO_3-N mg/1	Total N mg/1	Total P mg/1	Cu mg/1	Hg mg/1	Zn mg/1	Cd mg/1	As mg/1	B mg/1	Pb mg/1	LAS mg/1
1	4.7	34.4	-0-	155.0	98.9	0.87	2.02	0.29	< 0.10	.0009	< 0.02	<.006	.014	0.09	.010	.002
2	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
3	5.9	36.5	-0-	159.9	135.9	0.44	0.67	0.15	< 0.10	.0019	< 0.02	<.006	.008	0.13	.006	.050
4	6.2	40.1	-0-	178.2	134.0	0.30	0.54	0.14	< 0.10	.0007	< 0.02	<.006	.007	0.13	.006	.017
5	31.3	508.0	-0-	286.8	102.3	0.08	23.33	6.05	< 0.10	.0005	0.03	<.006	.003	0.42	.017	.017
6	24.2	271.6	-0-	281.9	88.4	0.06	33.55	8.40	< 0.10	.0005	0.04	<.006	.001	0.34	.014	.192
7	19.9	408.8	-0-	200.1	160.4	0.42	0.74	0.25	< 0.10	.0005	< 0.02	<.006	.010	0.19	.012	.006
8	6.6	52.5	-0-	172.1	97.0	0.59	1.34	0.13	< 0.10	.0006	< 0.02	<.006	.009	0.11	.007	.010
9	6.6	67.4	-0-	305.1	132.6	0.02	0.53	0.07	< 0.10	.0007	< 0.02	<.006	.007	0.11	.009	.002
10	13.3	168.4	-0-	330.7	564.8	0.08	0.81	0.06	< 0.10	.0006	< 0.02	<.006	.003	0.25	.012	.006
11	19.6	58.1	-0-	503.4	63.4	0.76	47.94	10.80	0.12	.0006	0.07	<.006	.001	1.66	.014	2.648
12	10.9	151.0	-0-	331.9	423.6	0.95	1.48	0.39	< 0.10	.0004	< 0.02	<.006	.003	0.29	.012	.013
13	12.5	145.0	-0-	250.2	503.4	0.48	1.48	0.14	< 0.10	.0003	< 0.02	<.006	.005	0.26	.012	.008
14	9.8	138.2	-0-	256.3	448.6	0.27	0.47	0.07	< 0.10	.0003	< 0.02	<.006	.005	0.22	.012	.006
15	16.8	207.7	-0-	270.9	653.2	0.55	1.48	0.07	< 0.10	.0005	< 0.02	<.006	.004	0.38	.022	.001
16	12.9	164.8	-0-	313.6	361.7	0.70	1.48	0.06	< 0.10	.0009	< 0.02	<.006	.004	0.24	.014	.006
17	13.7	176.2	-0-	349.0	372.2	0.59	1.28	0.07	< 0.10	.0006	< 0.02	<.006	.005	0.24	.011	.002
18	14.5	191.8	-0-	308.7	374.1	0.60	1.21	0.13	< 0.10	.0005	< 0.02	<.006	.004	0.23	.012	.002
19	9.0	120.5	-0-	303.9	304.5	0.19	0.54	0.07	< 0.10	.0005	< 0.02	<.006	.004	0.18	.011	.002

December Sampling Period

Sample No.	Location	Coliform AVG. Count/100ml	F. Coliform AVG. Count/100ml	C.O.D. mg/1	T.D.S. mg/1	EC mmhos	pH	Ca mg/1	Mg mg/1	Na mg/1
20	Las Cruces S.T.P. Effluent	310,000	260,000	62	920	1.30	7.46	85.6	21.3	186.0
21	Pichacho Drain above Mesilla Dam	140	50	18	1,196	1.51	7.90	144.5	26.5	192.2
22	Rio Grande at Mesilla Dam	5,150	60	24	1,284	1.62	7.96	141.7	29.7	202.8
23	Del Rio Drain near Vado	100	0	24	1,212	1.50	7.94	134.1	25.7	193.8
24	La Mesa Drain near Chamberino	600	300	30	1,692	2.00	7.89	213.8	37.4	218.2
25	Anthony, Texas S.T.P. Effluent	260	70	91	1,232	1.46	7.07	27.2	17.6	247.4
26	East Drain near La Tuna	200	167	34	2,344	3.16	8.04	141.5	40.5	492.0
27	Rio Grande below Anthony	18	170	14	1,420	1.84	8.28	141.5	31.1	237.9
28	Vinton River - Drain near Canutillo	---------	---------	---	-----	----	----	-----	----	-----
29	N. Mex. Drain near State Road 260	207	60	26	1,824	2.31	8.09	128.8	33.1	400.0
30	West Drain near State Road 260	191	67	18	1,836	2.27	7.97	135.1	38.5	367.6
31	Montoya Drain near the El Paso Electric Co. Power Plant	400	20	18	1,920	2.44	8.02	136.1	37.3	400.0
32	Rio Grande at El Paso near the El Paso Electric Co. Power Plant	60	45	16	1,664	2.11	8.23	152.1	33.4	290.4
33	El Paso City S.T.P. Effluent	1.55×10^6	900,000	216	880	1.29	7.19	64.9	13.7	200.0
34	Franklin Canal at Gage	--------	---------	---	------	----	----	------	----	------
35	Rio Grande at Island Station	--------	---------	---	------	----	----	------	----	------
36	Border Intercept Drain	306	300	62	3,464	4.69	7.61	269.7	18.7	894.5
37	Hudspeth Feeder Canal #1 near Guadalupe Bridge	30,000	9,000	50	2,652	3.46	7.82	231.7	48.3	599.1
38	El Paso Oxidation Pond Effluent	800,000	457,000	293	916	1.32	7.32	74.9	10.3	232.4
39	Tornillo Drain at Alamo Alto	20,300	15,000	87	1,308	1.79	7.34	95.0	22.6	287.4
40	Tornillo Drain at Outlet	500	260	38	3,044	4.86	7.76	322.4	60.0	799.1

December Sampling Period

Sample No.	K mg/1	Cl mg/1	CO_3 mg/1	HCO_3 mg/1	SO_4 mg/1	NO_3-N mg/1	Total N mg/1	Total P mg/1	Cu mg/1	Hg mg/1	Zn mg/1	Cd mg/1	As mg/1	B mg/1	Pb mg/1	LAS mg/1
20	20.3	175.8	-0-	325.8	185.4	5.13	9.88	8.65	< 0.10	.0006	0.03	< .006	.002	0.39	.014	.032
21	10.2	162.0	-0-	256.3	476.4	0.09	0.40	0.22	< 0.10	.0005	< 0.02	< .006	.006	0.21	.011	.002
22	14.5	198.5	-0-	264.8	383.8	1.45	1.68	0.55	0.10	.0005	< 0.02	< .006	.005	0.42	.011	.002
23	12.1	155.3	-0-	286.8	375.1	0.63	1.08	0.10	0.10	.0005	< 0.02	< .006	.005	0.26	.012	.001
24	12.9	230.1	-0-	336.8	556.2	0.56	1.01	0.18	0.10	.0005	< 0.02	< .006	.004	0.27	.017	.001
25	34.0	293.2	-0-	90.3	251.7	7.90	14.86	8.25	< 0.10	.0010	0.05	< .006	.006	0.43	.052	.001
26	52.0	515.1	-0-	428.3	639.8	0.50	0.94	0.60	< 0.10	.0006	< 0.02	< .006	.007	0.61	.038	.010
27	17.2	223.0	-0-	292.9	445.7	0.89	2.69	0.39	< 0.10	.0005	< 0.02	< .006	.004	0.30	.014	.018
28	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
29	10.5	301.0	-0-	355.1	560.5	0.04	0.27	0.10	< 0.10	.0004	< 0.02	< .006	.002	0.44	.022	.006
30	11.7	248.9	-0-	378.3	569.2	0.16	0.47	0.07	< 0.10	.0002	< 0.02	< .006	.008	0.49	.032	.002
31	10.9	312.7	-0-	377.1	596.1	0.21	0.67	0.13	< 0.10	.0004	< 0.02	< .006	.007	0.46	.033	.005
32	13.7	266.6	-0-	328.3	520.6	0.08	0.74	0.19	< 0.10	.0005	< 0.02	< .006	.007	0.38	.012	.005
33	17.6	188.2	-0-	262.4	194.0	2.17	25.68	7.95	< 0.10	.0012	< 0.02	< .006	.003	0.44	.036	.140
34	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
35	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
36	14.8	1088.0	-0-	346.6	750.2	0.08	0.67	0.37	< 0.10	.0014	< 0.02	< .006	.010	0.61	.070	.044
37	17.6	641.3	-0-	373.4	785.8	0.24	0.74	0.75	< 0.10	.0005	< 0.02	< .006	.007	0.50	.014	.025
38	22.7	182.6	-0-	448.5	110.9	5.69	33.55	9.90	< 0.10	.0009	< 0.02	< .006	.001	0.81	.017	.100
39	16.8	230.8	-0-	340.5	335.2	0.56	8.00	3.25	< 0.10	.0009	< 0.02	< .006	.004	0.45	.009	.066
40	18.0	1079.5	-0-	390.5	763.7	0.31	0.54	0.34	< 0.10	.0010	< 0.02	< .006	.012	0.57	.066	.030

December Sampling Period

Sample No.	Location	Coliform AVG. Count/100ml	F. Coliform AVG. Count/100ml	C.O.D. mg/l	T.D.S. mg/l	EC mmhos	pH	Ca mg/l	Mg mg/l	Na mg/l
41	Rio Grande at Fort Quitman	42	100	54	3,528	4.79	7.81	288.6	73.0	712.0
42	Fabens S.T.P. Effluent	12.4×10^6	7.8×10^6	200	876	1.25	7.27	71.7	15.8	184.1
43	El Paso S.T.P. above Saragosa Bridge Effluent	960,000	240,000	50	1,460	2.08	7.56	128.0	30.7	269.7
44	Ascarate, El Paso S.T.P. Effluent	4.73×10^6	3.97×10^6	230	764	1.20	7.18	54.5	9.1	186.0
45	Riverside Canal at its Heading	75,000	70,000	89	1,436	1.95	7.37	115.2	28.4	276.3

December Sampling Period

Sample No.	K mg/l	Cl mg/l	CO_3 mg/l	HCO_3 mg/l	SO_4 mg/l	NO_3-N mg/l	Total N mg/l	Total P mg/l	Cu mg/l	Hg mg/l	Zn mg/l	Cd mg/l	As mg/l	B mg/l	Pb mg/l	LAS mg/l
41	19.9	1004.0	-0-	353.9	882.8	0.24	0.81	0.99	< 0.10	.0008	< 0.02	< .006	.008	0.62	.070	.043
42	13.7	169.8	-0-	303.9	164.3	1.81	20.64	5.65	< 0.10	.0008	< 0.02	< .006	.002	0.27	.036	.058
43	16.4	262.7	-0-	308.7	444.8	0.64	2.02	1.54	< 0.10	.0008	< 0.02	< .006	.007	0.39	.009	.036
44	18.4	150.7	-0-	325.8	116.8	5.06	36.44	8.90	< 0.10	.0010	< 0.02	< .006	.003	0.32	.046	.066
45	16.0	249.6	-0-	302.6	399.1	0.95	3.09	7.05	< 0.10	.0015	< 0.02	< .006	.005	0.45	.016	.059

PESTICIDE ANALYSIS

The Office of the State Chemists reports that for the 40 water samples submitted for this study in December, 1975 that:

There were no pesticide residues found in any of the samples at or above the levels given below for he indicated pesticides:

(a) chlorinated hydrocarbons	Level mg/l
heptachlor	0.0001
lindane	0.004
endrin	0.002
methoxychlor	0.05
heptachlor epoxide	0.0001

(b) organophosphates	Level mg/l
ethion	0.02
methyl parathion	0.003
parathion	0.003
malathion	0.003
dizzinon	0.002

RIO GRANDE WATER QUALITY BASE LINE STUDY

1974-75

FOR THE RIO GRANDE CANALS AND ASSOCIATED DRAINS

FROM SAN MARCIAL, NEW MEXICO TO FORT QUITMAN, TEXAS

HISTORICAL RECORDS

APPENDIX B

APPENDIX B*

RIO GRANDE WATER QUALITY BASE LINE STUDY

1974-75

For the Rio Grande, Canals and Associated Drains

From San Marcial, New Mexico to Fort Quitman, Texas

HISTORICAL RECORDS

A. Sources of Data

As a part of the Rio Grande Base Line Project for the U. S. Bureau of Reclamation, a sincere effort has been made to assemble, in one place, a summary of all of the water quality data available for the river, its canals and drains from San Marcial, New Mexico at the upper end of Elephant Butte to Fort Quitman, Texas at the lower end of the irrigated lands in the El Paso Valley. There are other records available that have not been included because of their short-duration, their limited areal extent, or their quality.

Some of the data presented in this text represents average values for the indicated period rather than all of the raw data available. Summaries have been included because of the large volume of the raw data. For example, some of the data is representative of the quality that prevailed throughout a month and may be based on more than one sample. Typically the flow cited is not the average monthly flow, but is the average of the flows that prevailed at the times of sample collection during the month. The limitations on the data are described at the start of each section. The data is presented in sets from the various sources from which it is taken. These sources are given in subsections 1 through 5 below.

1. U. S. Geological Survey, Water Supply Paper 839, "Quality of Water of The Rio Grande Basin Above Fort Quitman, Texas Analytical Data", By Carl S. Scofield, U. S. Geological Survey, United States Government Printing Office, 1938.

   Stations and Period of Record

   El Paso 1918-1932

   Leasburg Dam 1920-1936

   San Marcial 1920-1932

   Elephant Butte Dam 1920-1936

   Garfield Drain 1921-1936

   Ft. Quitman 1927-1932

* Bound Separately

Angostura Drain 1926-1936
Rincon Drain 1925-1936
Picacho Drain 1922-1936
Mesilla Drain 1919-1936
Del Rio Drain 1921-1936
La Mesa Drain 1919-1936
East Drain 1918-1936
Anthony Drain 1918-1936
Nemexas Drain 1918-1936
West Drain 1918-1936
Montoya Drain 1919-1936
Selden Drain 1921-1936
Hatch Drain 1924-1936
Chamberino 1919-1936

2. International Boundary and Water Commission, Annual Water Bulletins, "Flow of The Rio Grande and Related Data," 1933 through 1973.
Stations and Period of Record
El Paso 1933-1973
Leasburg Dam 1939-1950
Caballo Dam 1939-1950
San Marcial 1933-1946
Ft. Quitman 1933-1973

3. "Discharge and Salt Burden of the Rio Grande above Fort Quitman, Texas, and Salt-Balance Conditions on the Rio Grande Project, Summary Report for the 30 year Period 1934-1963," L. V. Wilcox, U.S. Salinity Laboratory Research Report No. 113, United States Salinity Laboratory, Riverside, California, Issued August 30, 1968.
Stations and Period of Record
Leasburg Dam 1937-1938 1951-1963
Caballo Dam 1951-1963
San Marcial 1947-1963
Elephant Butte Dam 1936-1963

4. Water Resources Data for New Mexico, Part 2. Water Quality Records, U. S. Geological Survey, Albuquerque, New Mexico 87106.
   Station and Period of Record
   San Marcial 1964-1969

5. U. S. Bureau of Reclamation, Rio Grande Project Office, El Paso, Texas, unpublished data.
   Stations and Period of Record
   Arrey Canal 1970-1974
   East Side Canal 1970-1974
   West Side Canal 1970-1974
   Leasburg Canal 1970-1974
   Garfield Drain 1937-1965
   Angostura Drain 1937-1965
   Rincon Drain 1937-1965
   Picacho Drain 1937-1965
   Mesilla Drain 1937-1965
   Santo Tomas 1937-1965
   Del Rio Drain 1937-1965
   La Mesa Drain 1937-1965
   East Drain 1937-1965
   Anthony Drain 1937-1965
   NeMexas Drain 1937-1965
   West Drain 1937-1965
   Montoya Drain 1937-1965
   Selden Drain 1937-1965
   Hatch Drain 1937-1965
   Chamberino 1937-1965

B. Special Notations

The historical records were transcribed from their original source into a common set of parameters and common notations. As the records were put directly into computer storage some modifications were necessary. To make common storage possible, some of the data has been transformed from the original units into those given in the tables. These conversions (for example, transfer from milligram equivalents to milligrams per liter) were done by a computer program that did not truncate values at a significant figure for the particular chemical analysis. For that reason, some values are given to what might appear to be inappropriate levels of significance. There are other minor changes that may at first observation seem erroneous, but they were necessary to permit data management. A number of abbreviations were used as follows:

MNTH	Month
SMPLS	Samples
TDS	Total Dissolved Solids
E.C.	Electrical Conductivity in mhos
BORON	Boron
PH	pH
NA	Sodium ion
CL	Chloride ion
CA	Calcium ion
MG	Magnesium ion
SO4	Sulfate ion
NO3	Nitrate ion
FLOW	Discharge
#	Number
MG/L	Milligrams per Liter
E-6	1/1,000,000
%	Percent
CFS	Cubic Feet Per Second

RIO GRANDE WATER QUALITY BASE LINE STUDY

1974-75

FOR THE RIO GRANDE CANALS AND ASSOCIATED DRAINS

FROM SAN MARCIAL, NEW MEXICO TO FORT QUITMAN, TEXAS

GRAPHICAL PRESENTATION OF STUDY DATA

APPENDIX C

LIST OF FIGURES - APPENDIX C

Figure Page

Figure 1

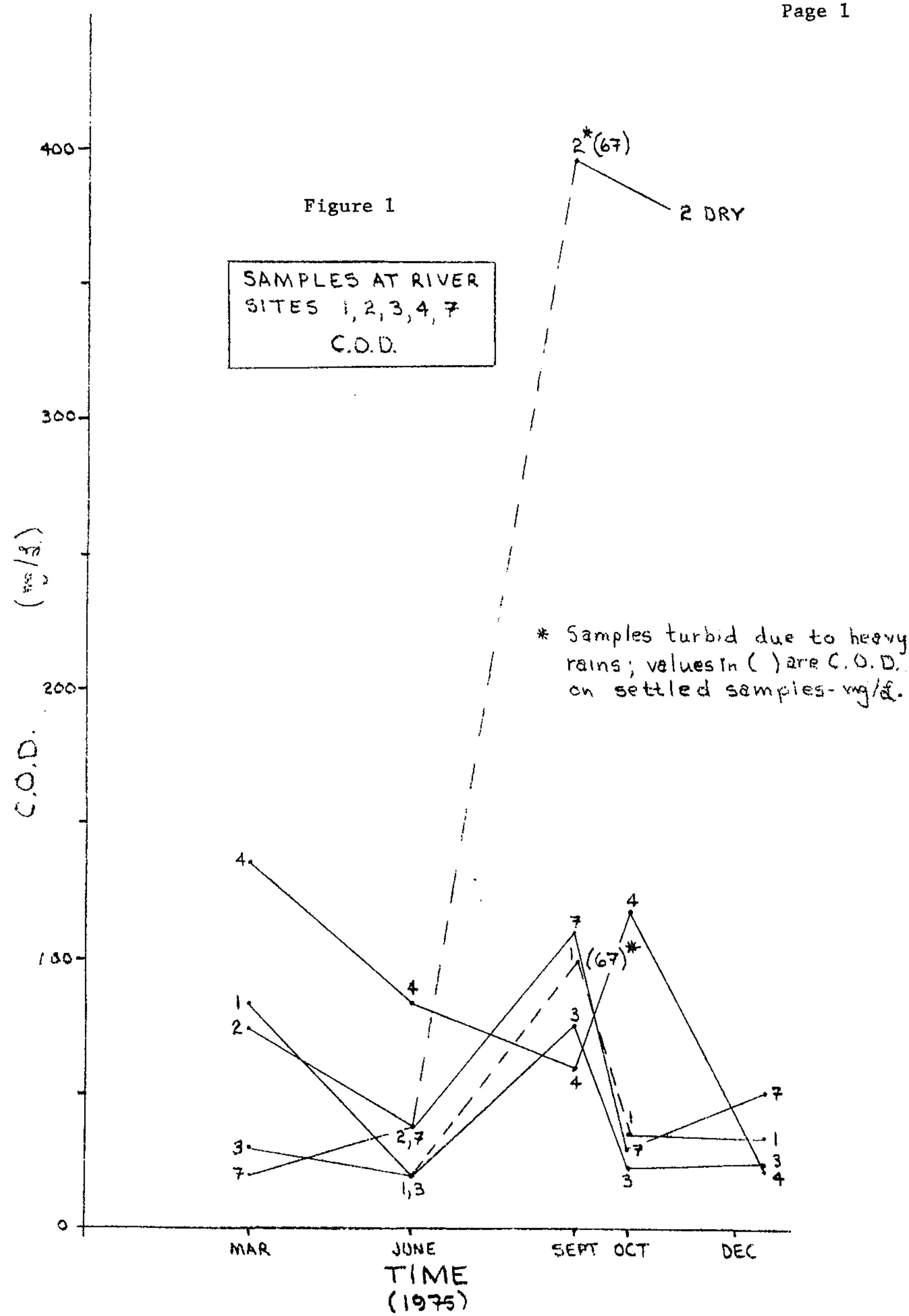

SAMPLES AT RIVER
SITES 1,2,3,4,7
C.O.D.
2*(67)
2 DRY
* Samples turbid due to heavy rains; values in ( ) are C.O.D. on settled samples-mg/ℓ.
(67)*
C.O.D. (mg/ℓ)
400
300
200
100
0
MAR
JUNE
SEPT
OCT
DEC
TIME
(1975)

Figure 2

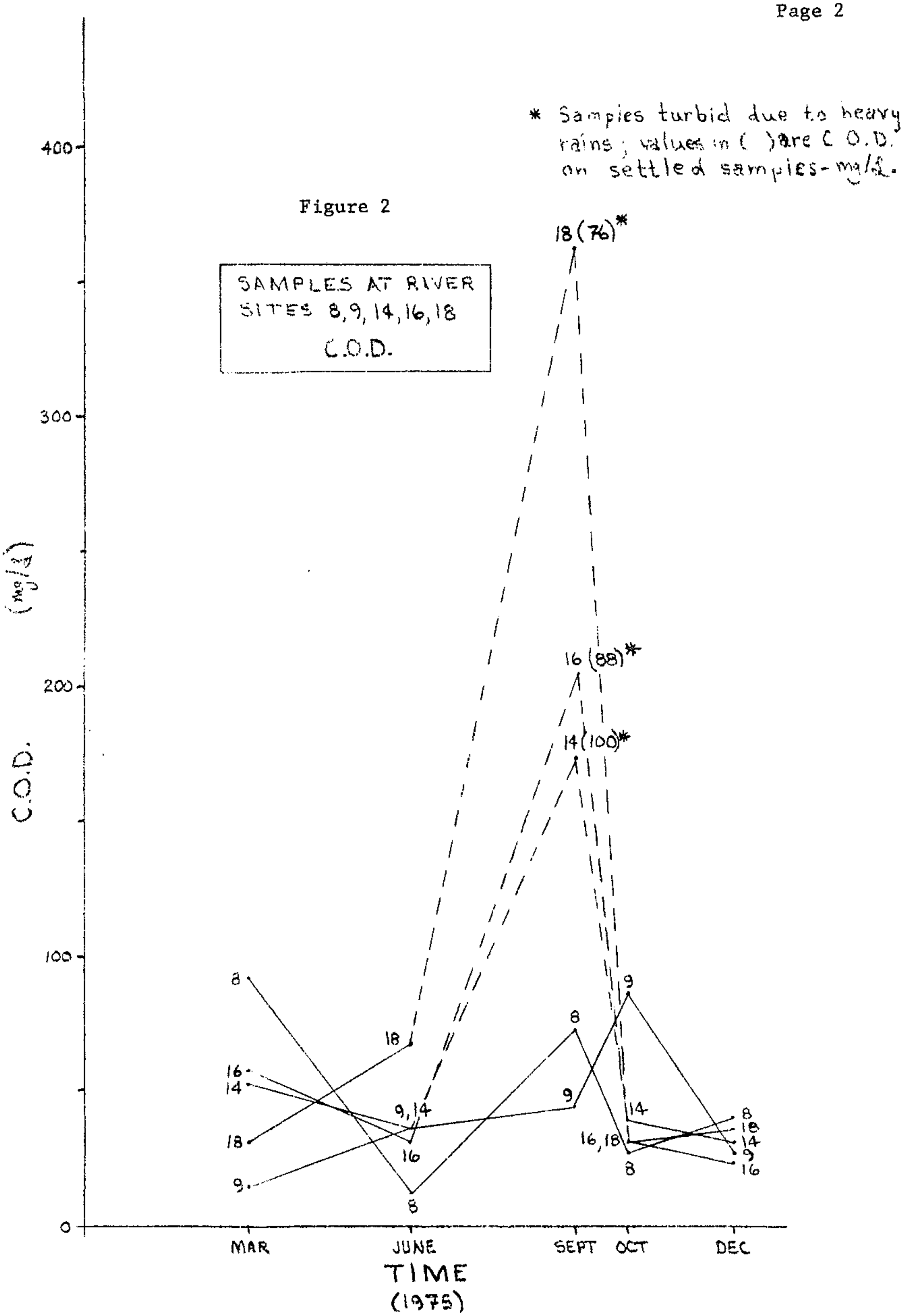

* Samples turbid due to heavy rains; values in ( ) are C.O.D. on settled samples-mg/l.
SAMPLES AT RIVER SITES 8,9,14,16,18
C.O.D.
C.O.D.
(mg/l)
400
300
200
100
0
18 (76)*
16 (88)*
14 (100)*
MAR
JUNE
SEPT
OCT
DEC
TIME
(1975)

Figure 3

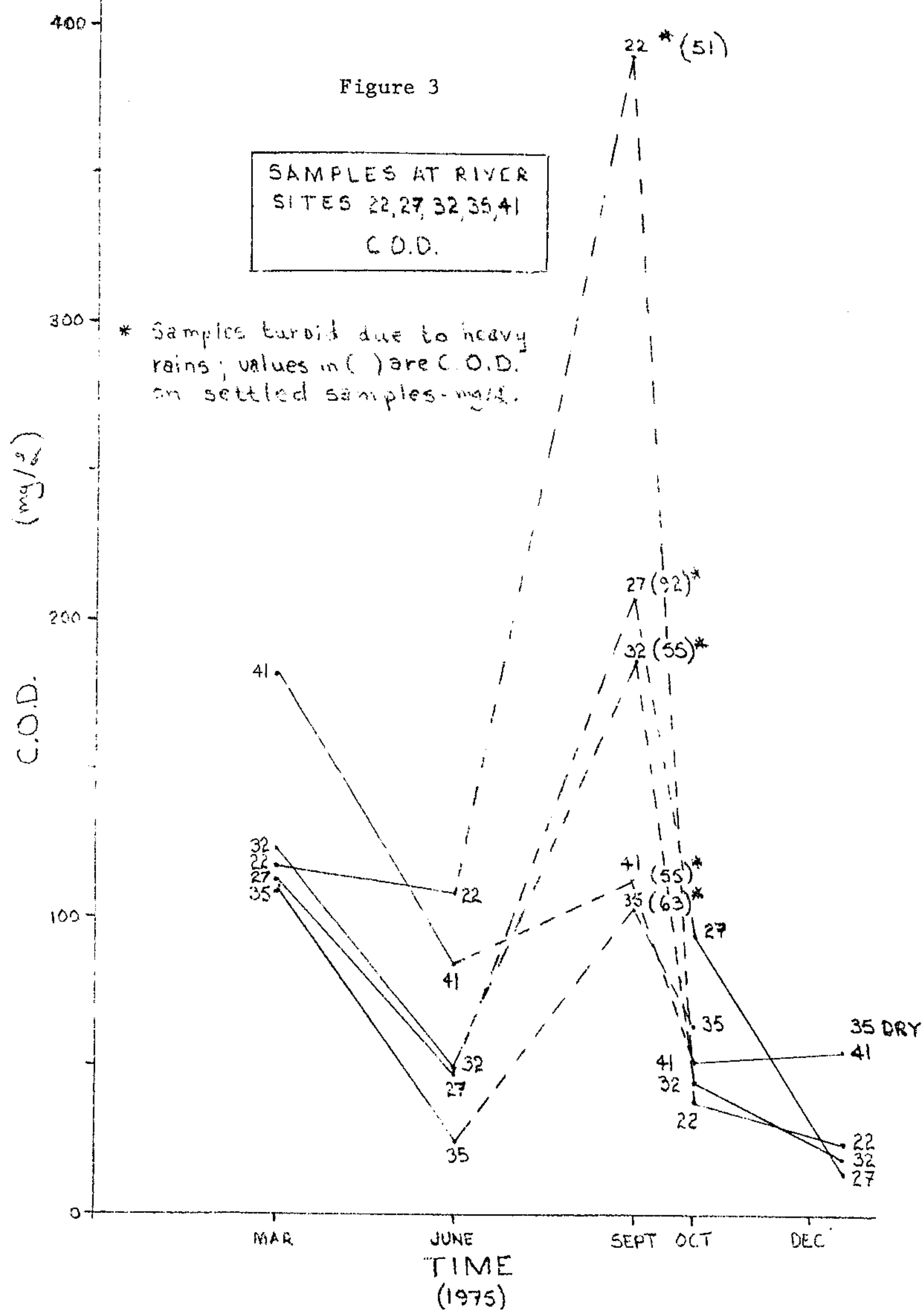
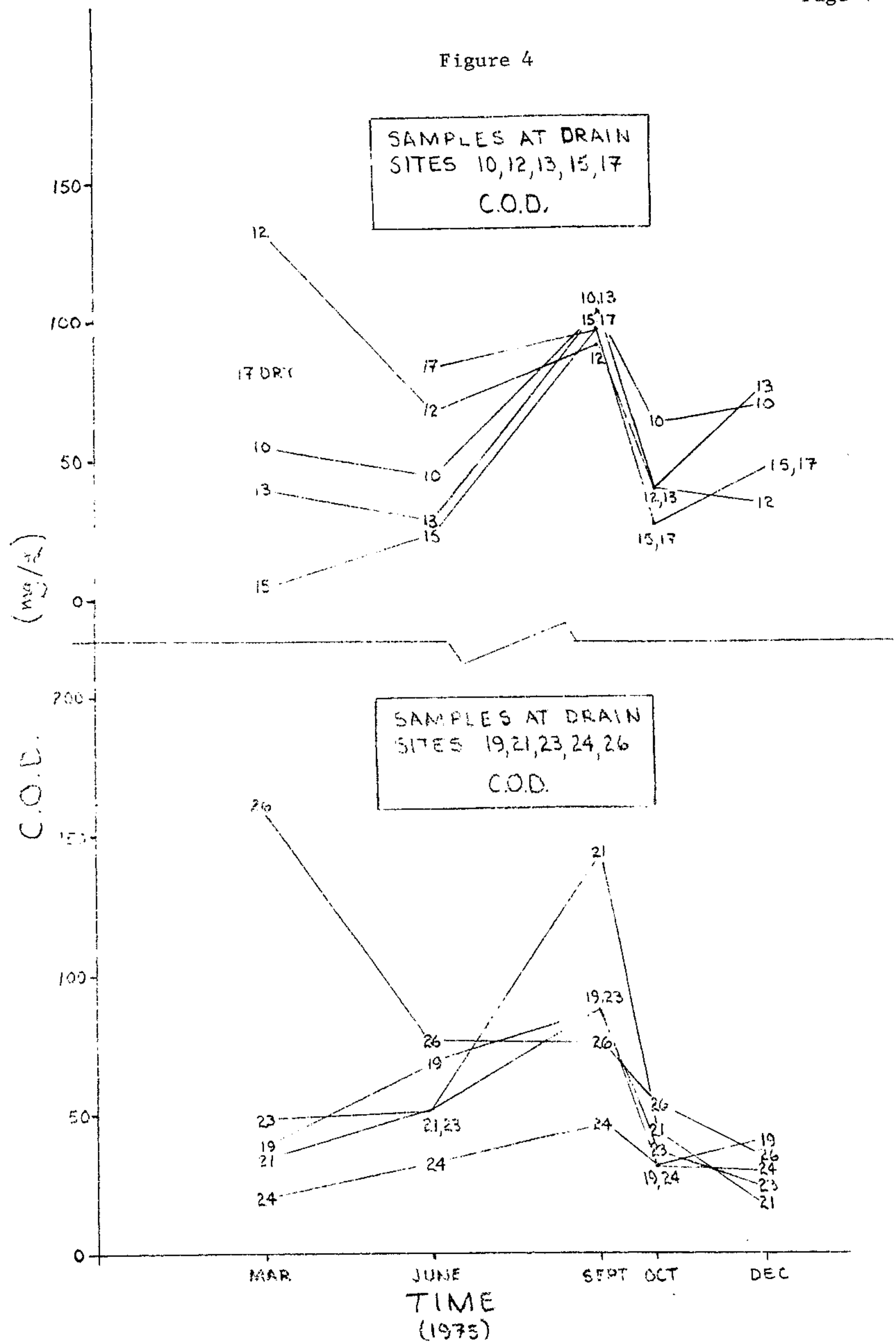

SAMPLES AT RIVER SITES 22, 27, 32, 35, 41
C.O.D.
* Samples turbid due to heavy rains; values in ( ) are C.O.D. on settled samples-mg/l.
C.O.D. (mg/l)
400
300
200
100
0
22 *(51)
27 (92)*
32 (55)*
41 (55)*
35 (63)*
41
32
22
27
35
22
41
32
27
35
27
35
41
32
22
35 DRY
41
22
32
27
MAR
JUNE
SEPT
OCT
DEC
TIME
(1975)

Figure 4



SAMPLES AT DRAIN SITES 10,12,13,15,17
C.O.D.
SAMPLES AT DRAIN SITES 19,21,23,24,26
C.O.D.
17 DRY
C.O.D. (mg/l)
150
100
50
0
200
100
50
0
MAR
JUNE
SEPT
OCT
DEC
TIME
(1975)

Figure 5

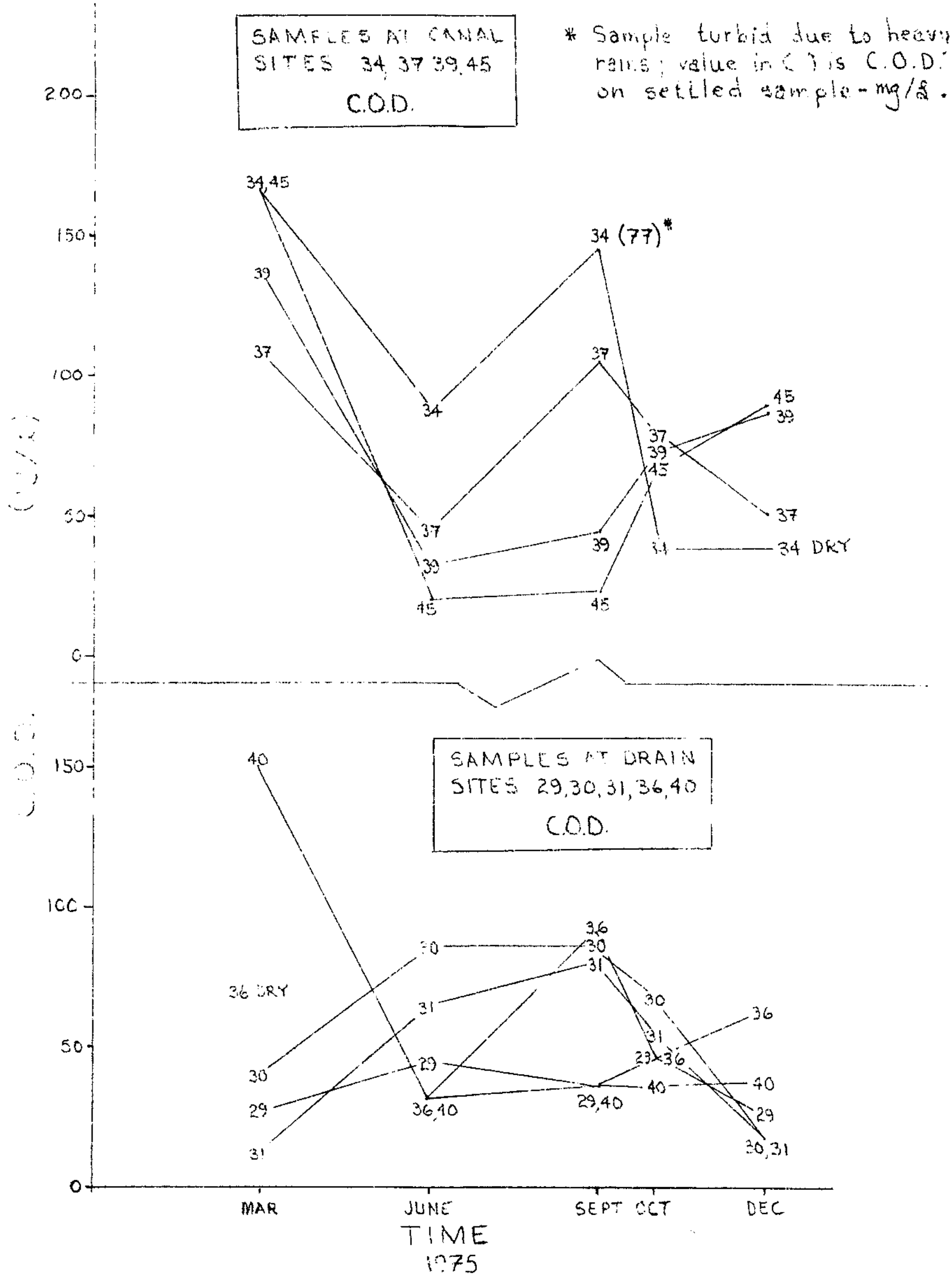

SAMPLES AT CANAL SITES 34, 37 39, 45
C.O.D.
* Sample turbid due to heavy rains; value in ( ) is C.O.D. on settled sample - mg/l.
34,45
39
37
34 (77)*
34
37
39
45
34 DRY
SAMPLES AT DRAIN SITES 29,30,31,36,40
C.O.D.
40
36 DRY
30
29
31
36,40
29,40
36
30
31
40
29
30,31
0
50
100
150
200
MAR
JUNE
SEPT
OCT
DEC
TIME
1975

Figure 6

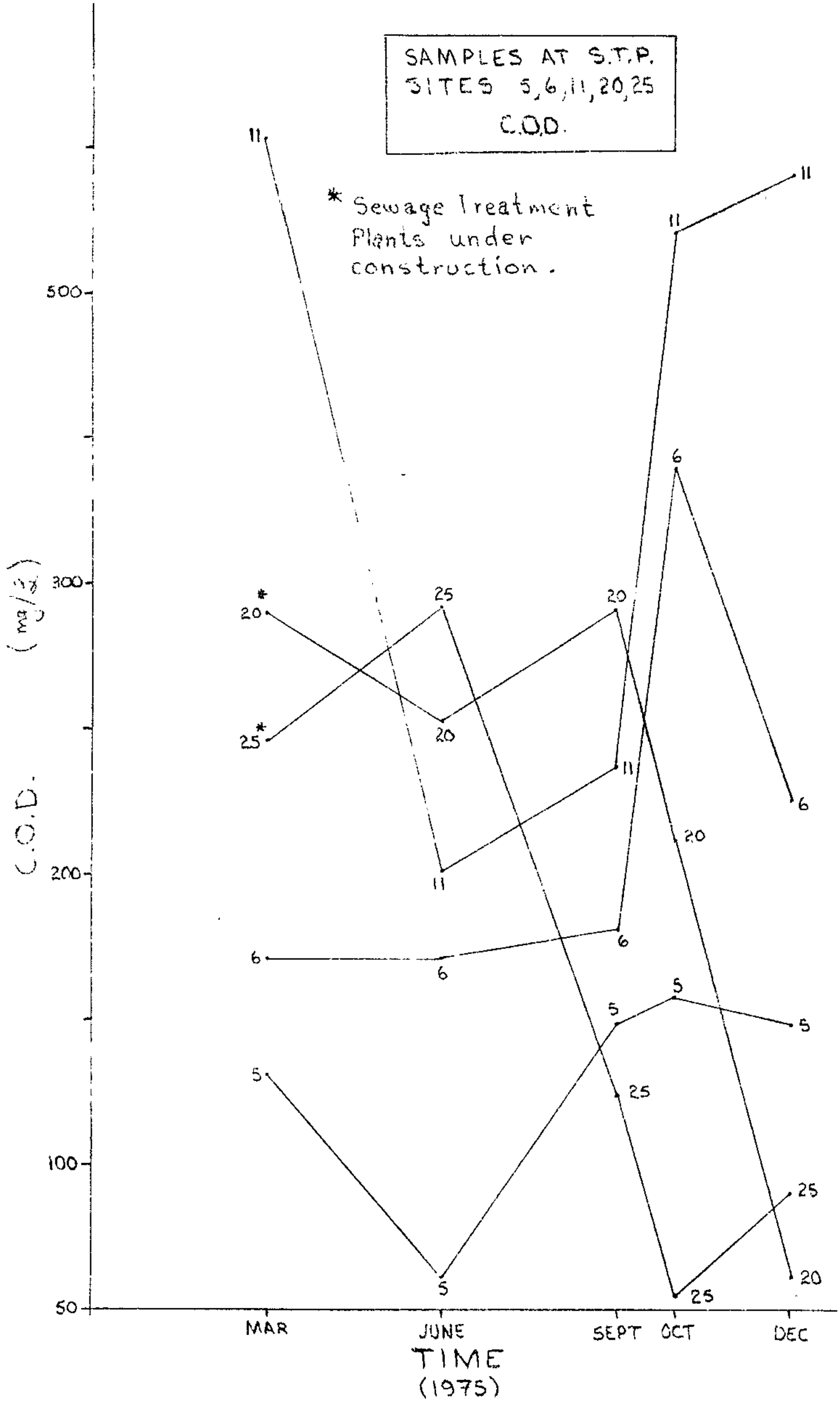

SAMPLES AT S.T.P.
SITES 5,6,11,20,25
C.O.D.
* Sewage Treatment Plants under construction.
C.O.D. (mg/l)
500
300
200
100
50
MAR
JUNE
SEPT
OCT
DEC
TIME
(1975)

Figure 7

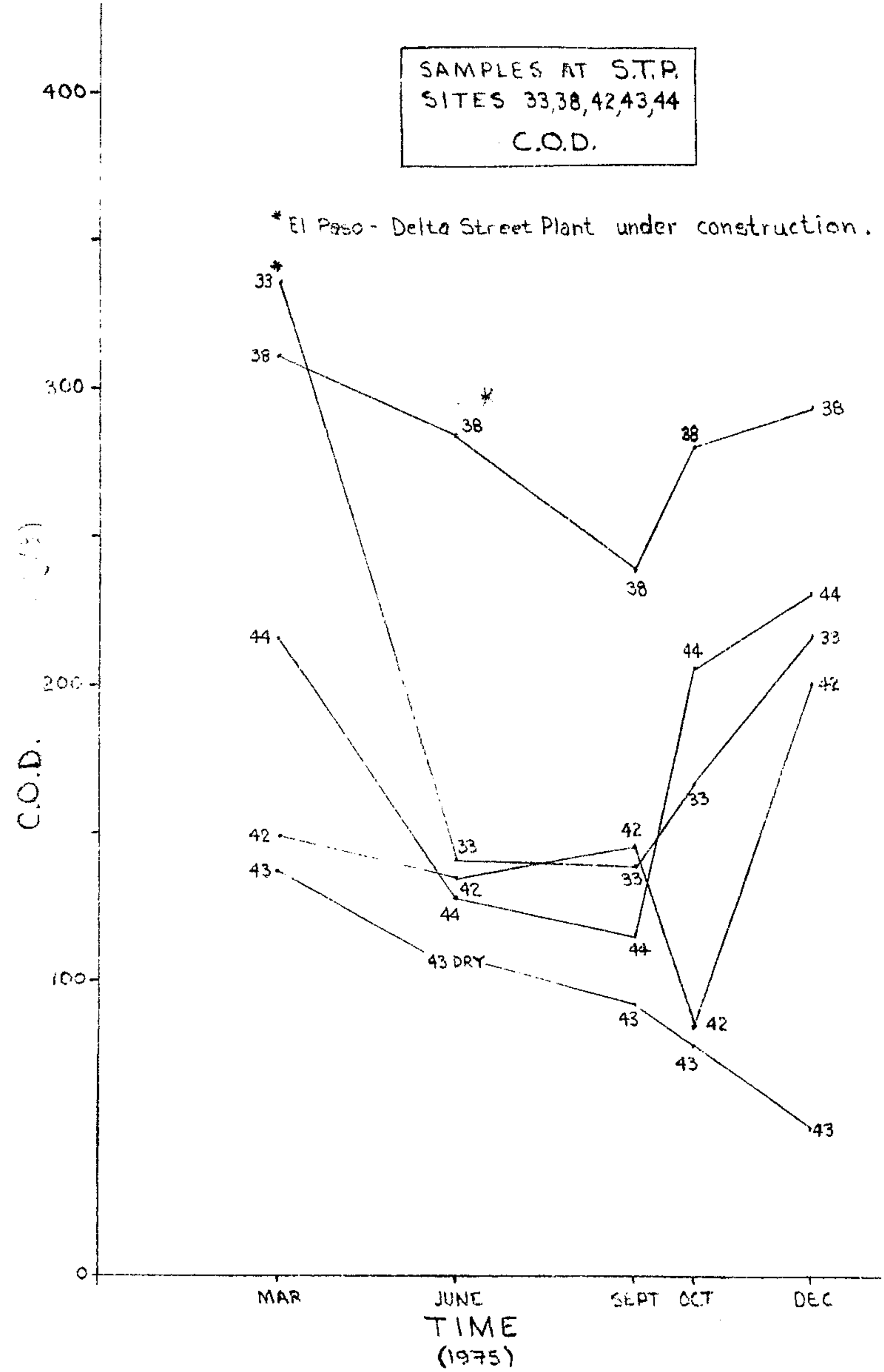

SAMPLES AT S.T.P.
SITES 33,38,42,43,44
C.O.D.
* El Paso - Delta Street Plant under construction.
400
300
200
100
0
C.O.D.
33
38
44
42
43
43 DRY
MAR
JUNE
SEPT
OCT
DEC
TIME
(1975)

Figure 8

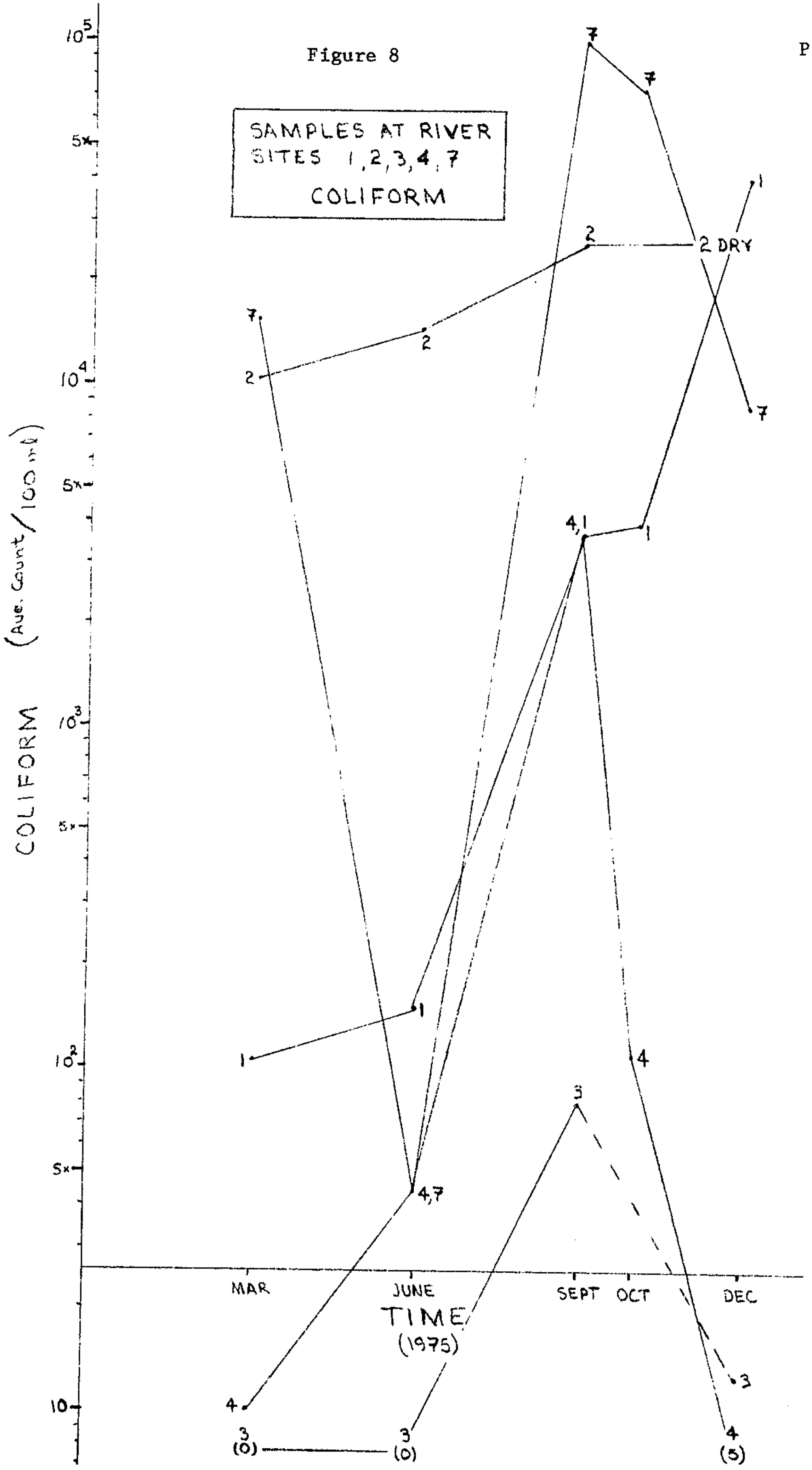

SAMPLES AT RIVER
SITES 1,2,3,4,7
COLIFORM
COLIFORM (Ave. Count/100 ml)
10^5
5x
10^4
5x
10^3
5x
10^2
5x
10
MAR
JUNE
SEPT
OCT
DEC
TIME
(1975)
2 DRY
4,1
4,7
3 (0)
4 (5)

Figure 9

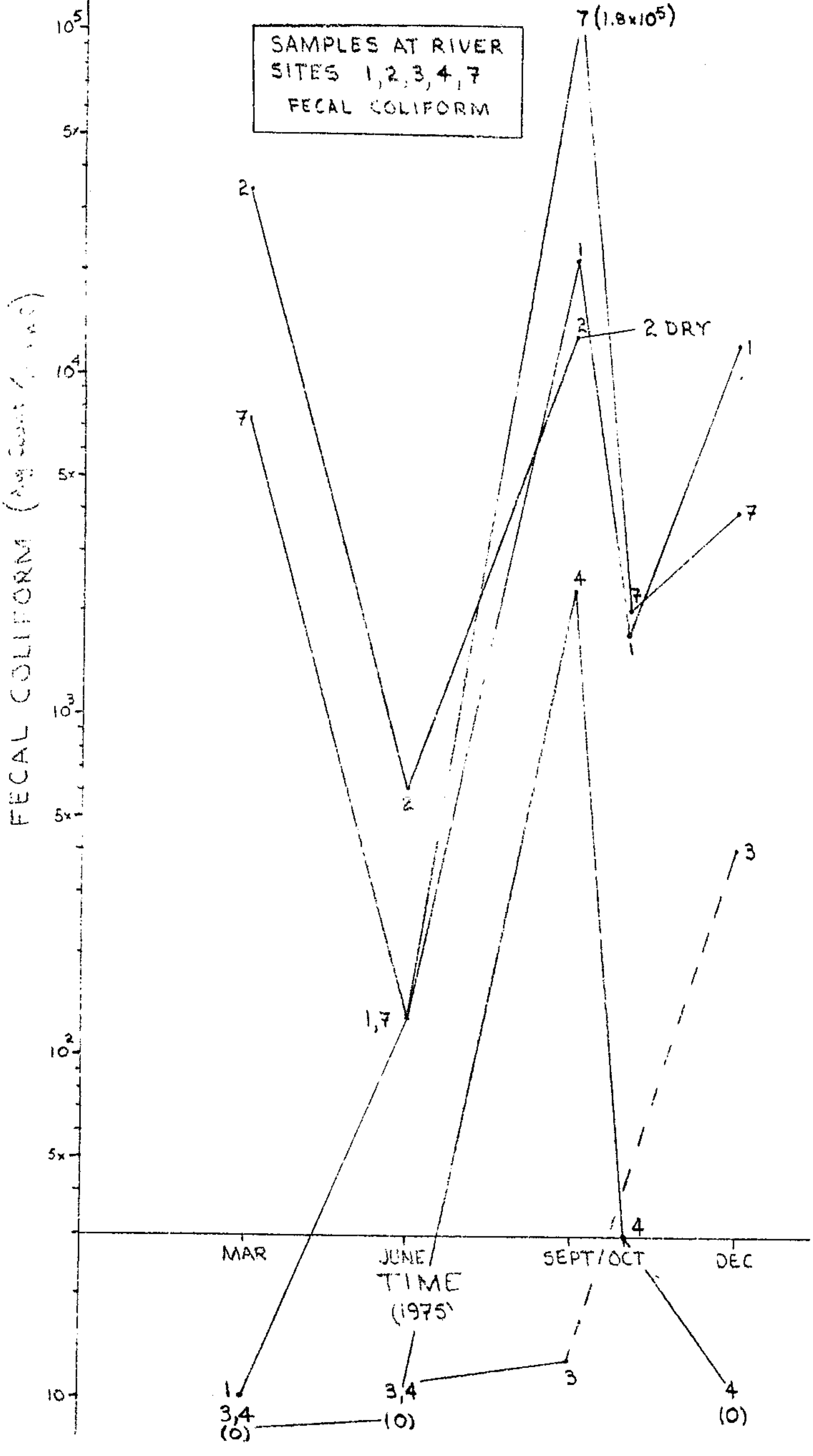
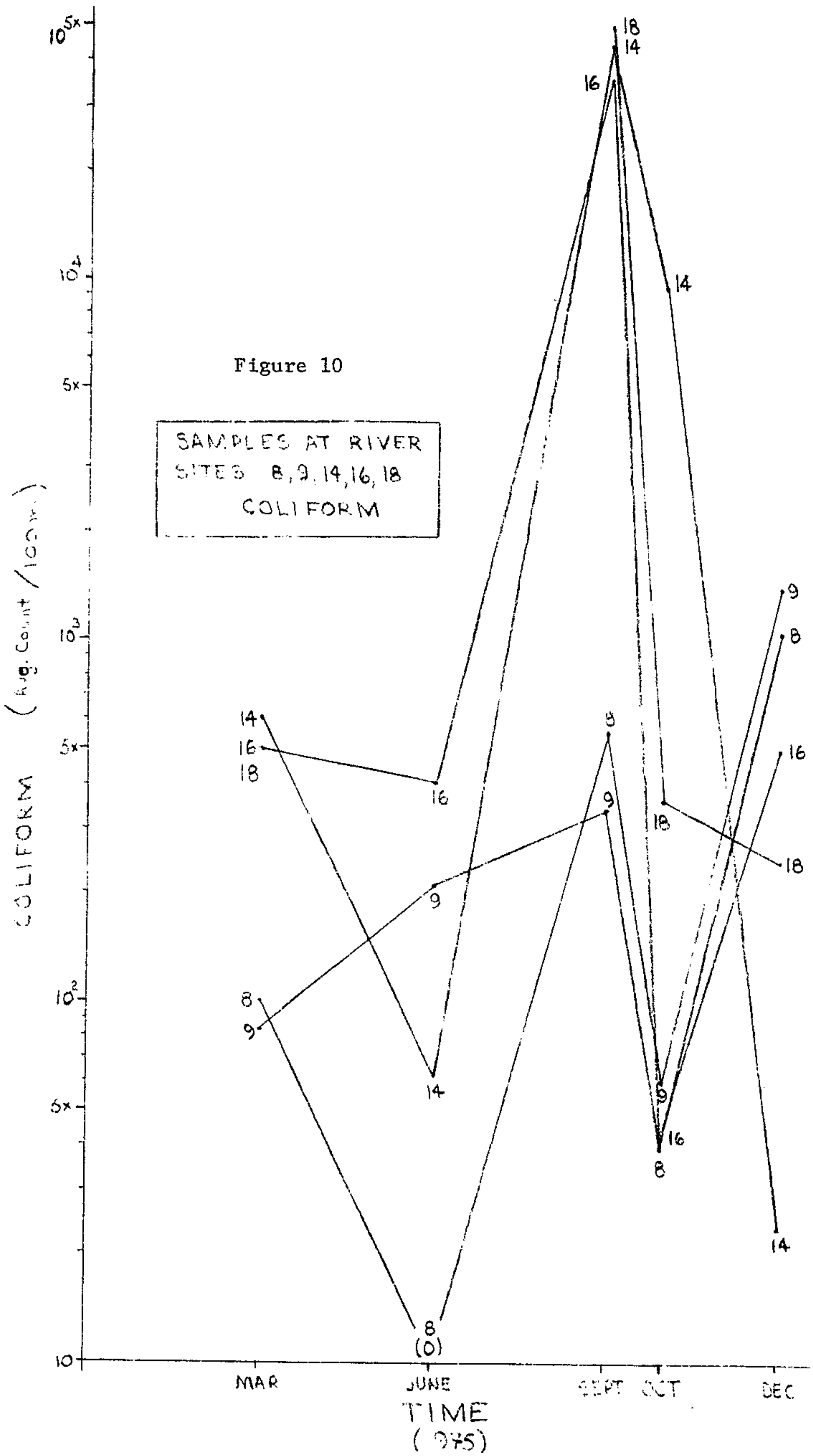

SAMPLES AT RIVER
SITES 1,2,3,4,7
FECAL COLIFORM
FECAL COLIFORM
TIME
(1975)
MAR
JUNE
SEPT/OCT
DEC
2 DRY
7 (1.8x10^5)

Figure 10



SAMPLES AT RIVER
SITES 8, 9, 14, 16, 18
COLIFORM
COLIFORM (Avg. Count / 100ml)
TIME
MAR
JUNE
SEPT
OCT
DEC
10
5×
10²
10³
10⁴
10⁵×

Figure 11

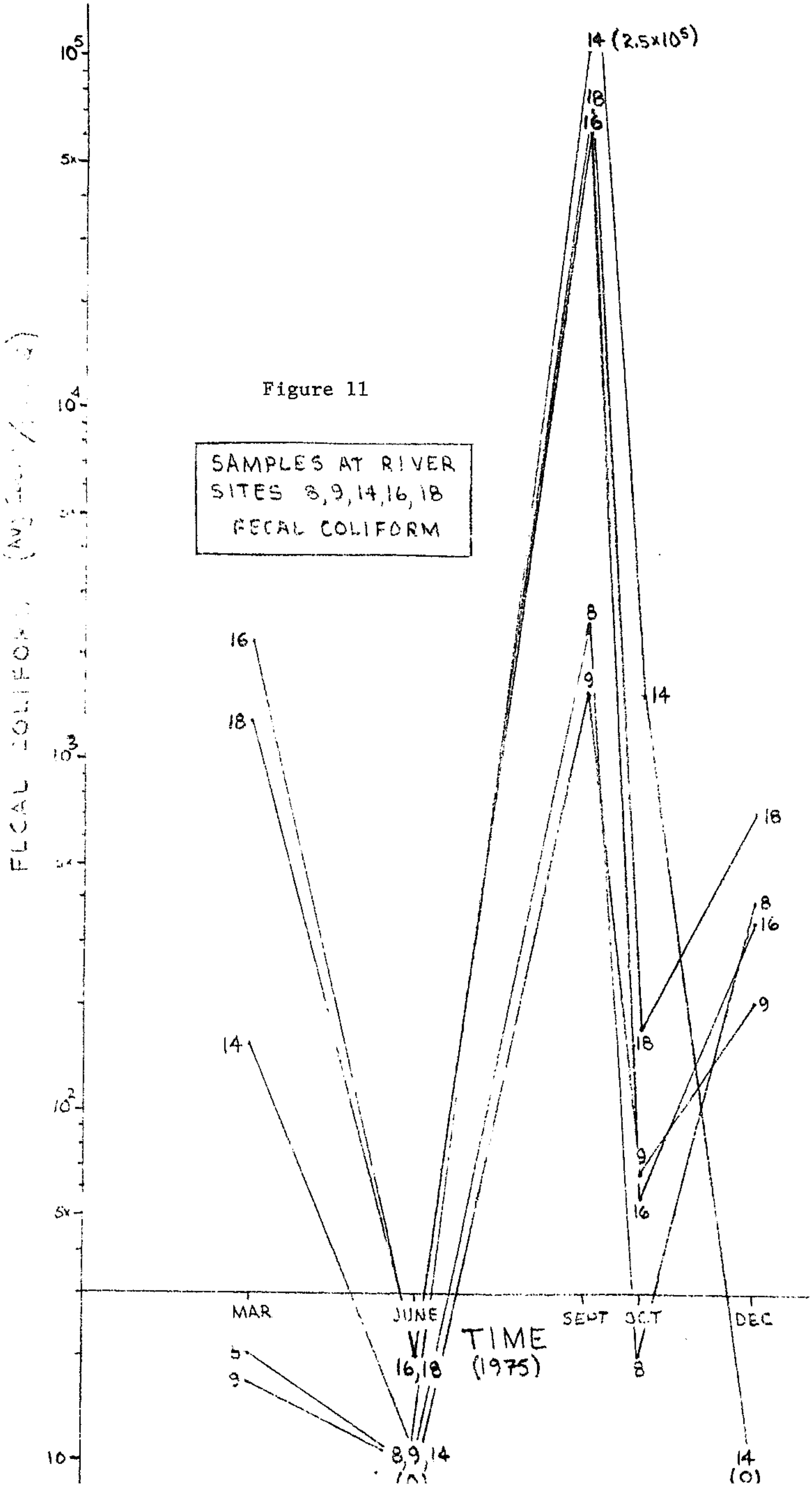

SAMPLES AT RIVER
SITES 8,9,14,16,18
FECAL COLIFORM
TIME
(1975)
MAR
JUNE
SEPT
OCT
DEC
14 (2.5×10⁵)

Figure 12

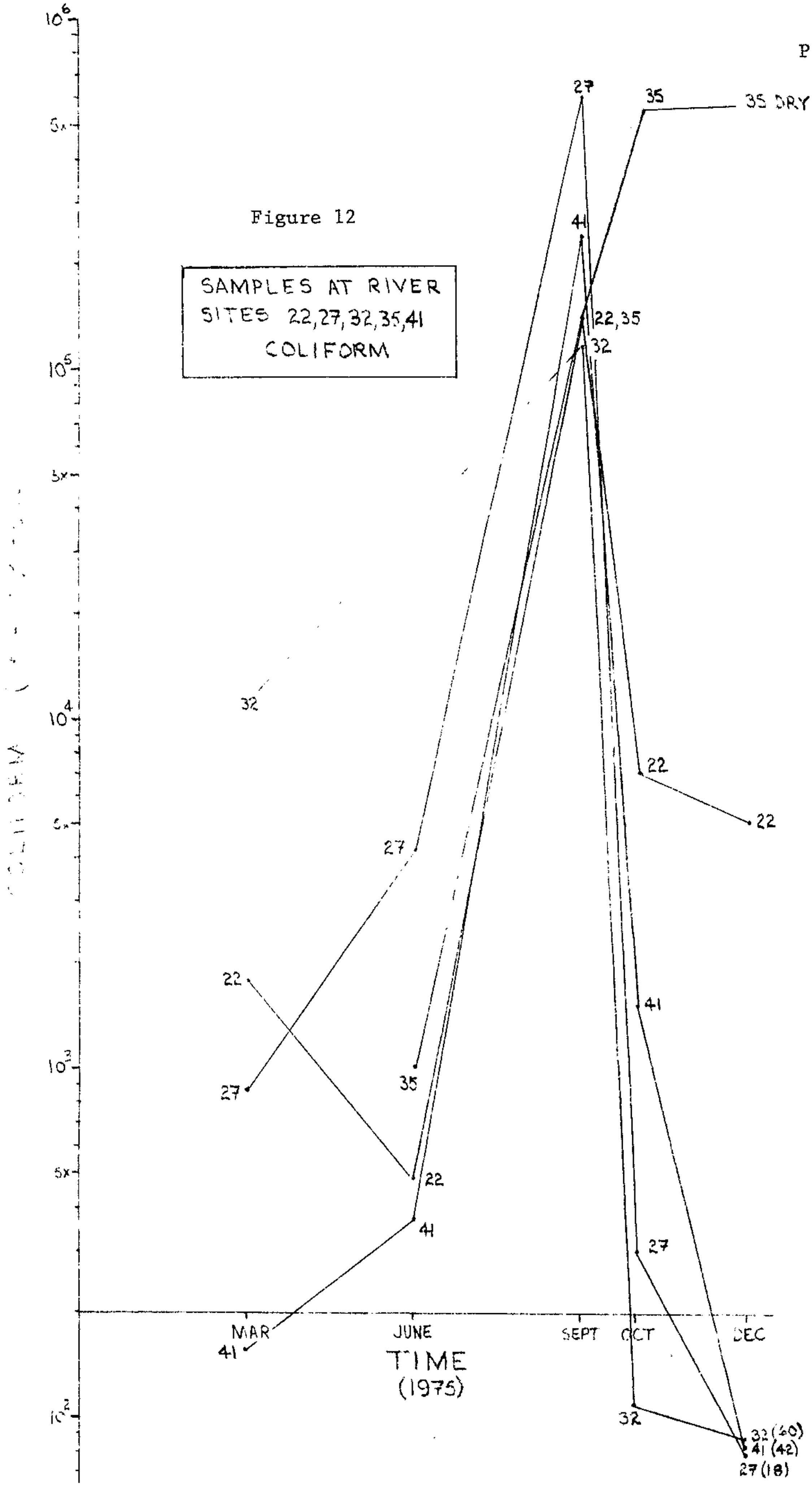

SAMPLES AT RIVER
SITES 22,27,32,35,41
COLIFORM
TIME
(1975)
MAR
JUNE
SEPT
OCT
DEC
35 DRY
32 (30)
41 (42)
27 (18)

Figure 13

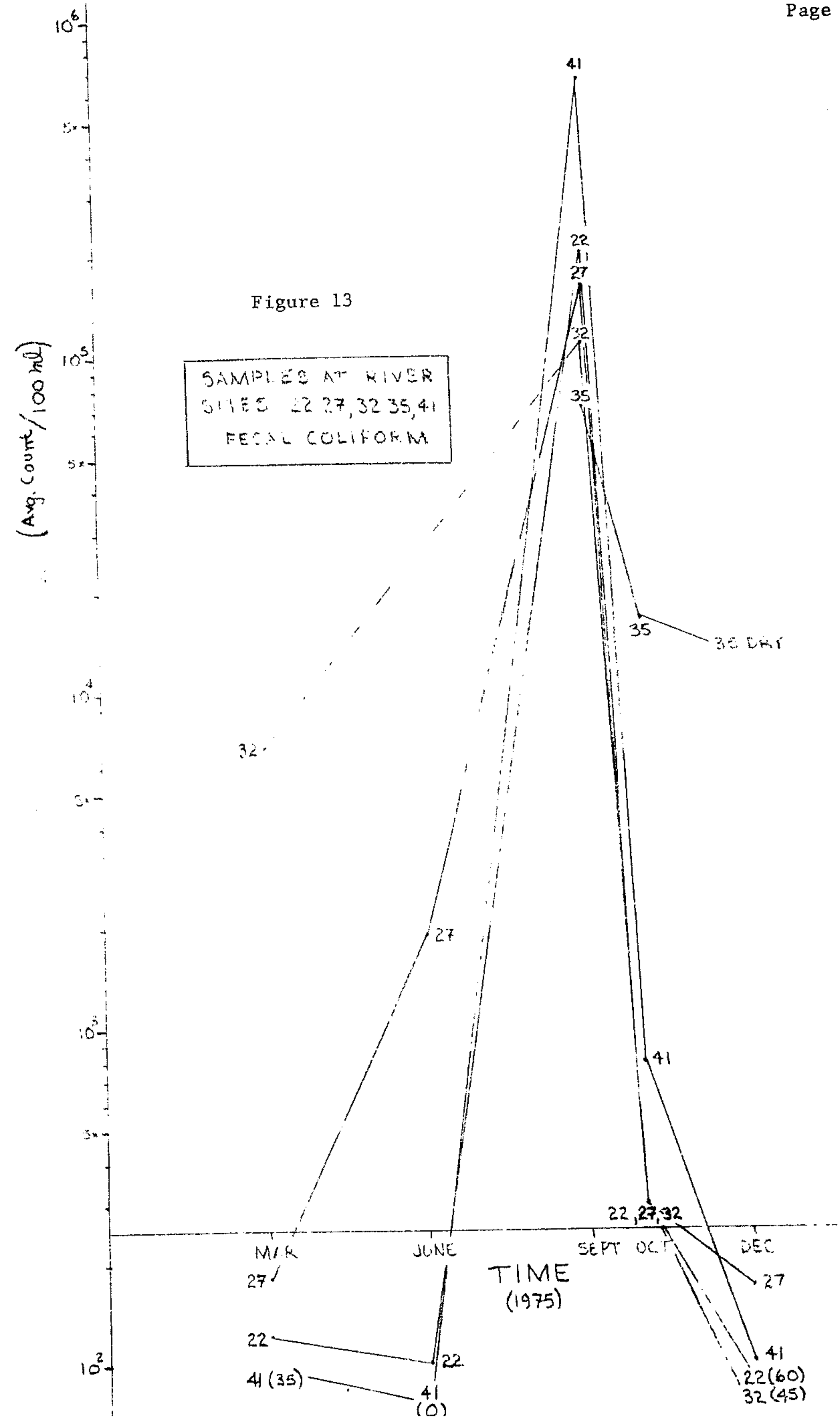
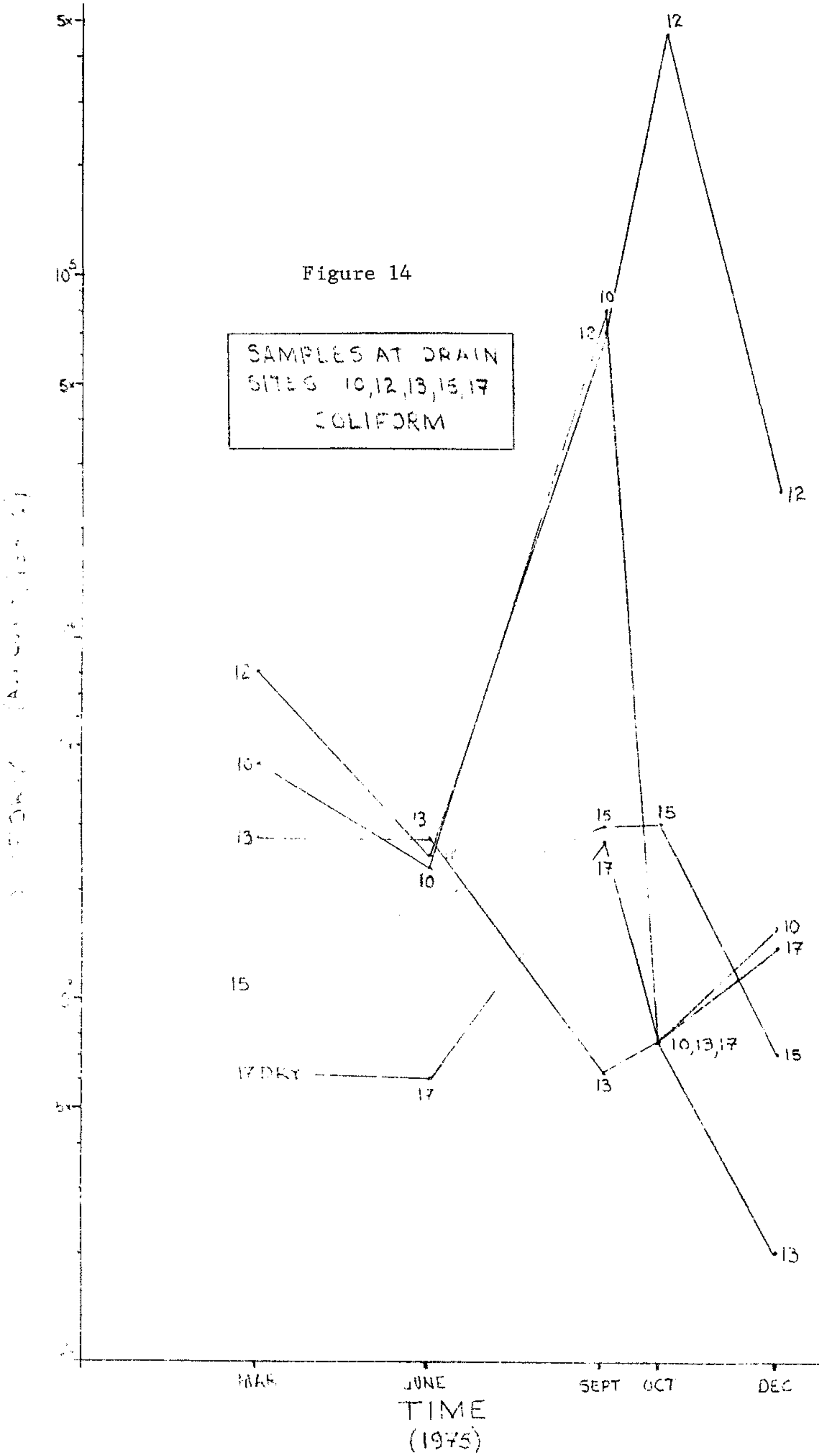

SAMPLES AT RIVER
SITES 22 27, 32 35, 41
FECAL COLIFORM
(Avg. Count/100 ml)
TIME
(1975)
MAR
JUNE
SEPT
OCT
DEC
35 DRY
22, 27, 32
41 (35)
41 (0)
22 (60)
32 (45)

Figure 14


SAMPLES AT DRAIN
SITES 10,12,13,15,17
COLIFORM
12
10
13
15
17 DRY
10,13,17
MAR
JUNE
SEPT
OCT
DEC
TIME
(1975)

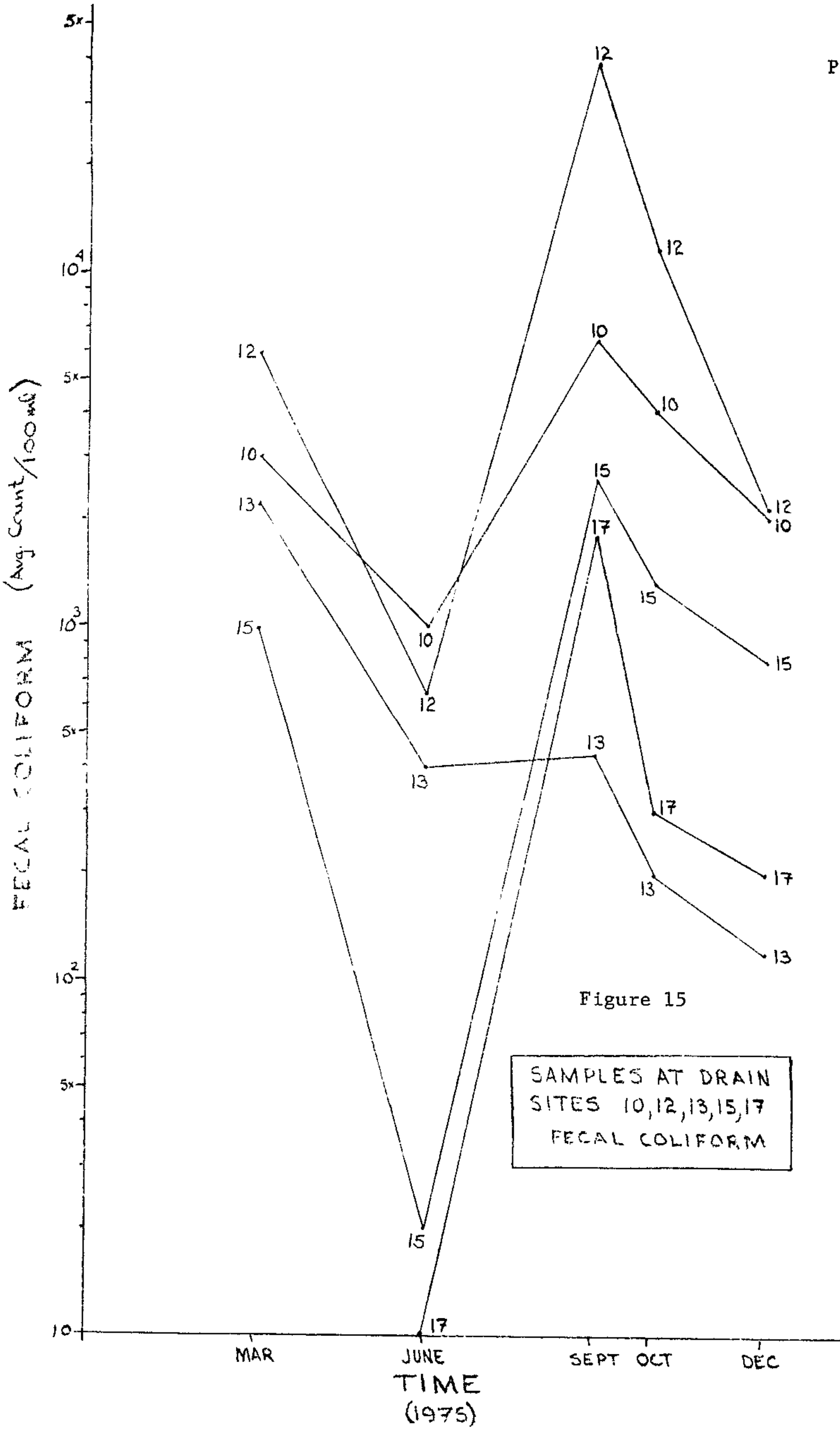
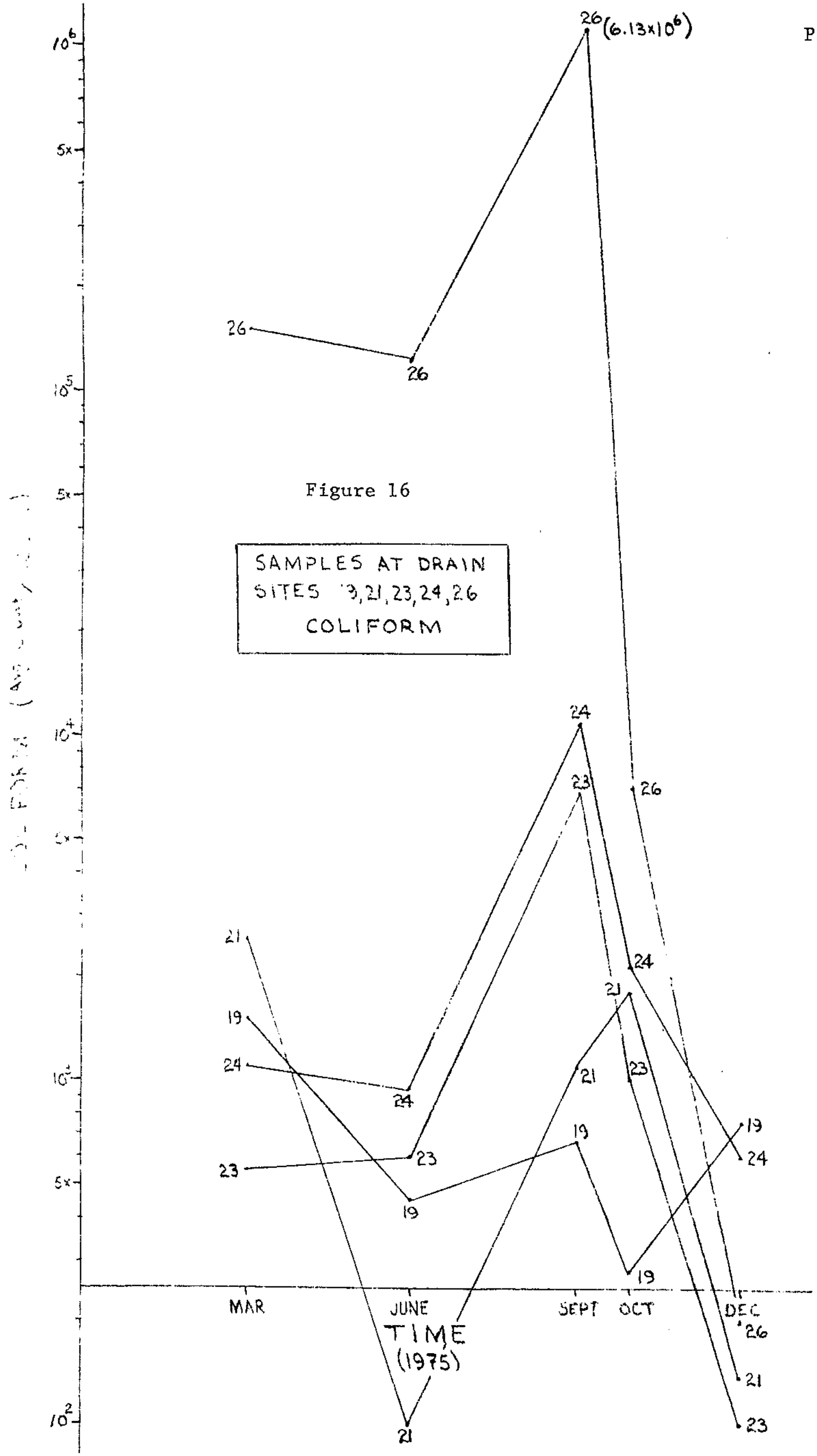

5×
10⁴
5×
10³
5×
10²
5×
10
FECAL COLIFORM (Avg. Count/100 ml)
MAR
JUNE
SEPT OCT
DEC
TIME
(1975)
12
10
13
15
17
SAMPLES AT DRAIN
SITES 10,12,13,15,17
FECAL COLIFORM

Figure 15


26 (6.13x10^6)
26
26
Figure 16
SAMPLES AT DRAIN SITES 19,21,23,24,26 COLIFORM
24
23
26
21
19
24
24
21
23
21
23
19
19
23
24
19
19
21
MAR
JUNE
SEPT
OCT
DEC
TIME (1975)
26
21
23
21

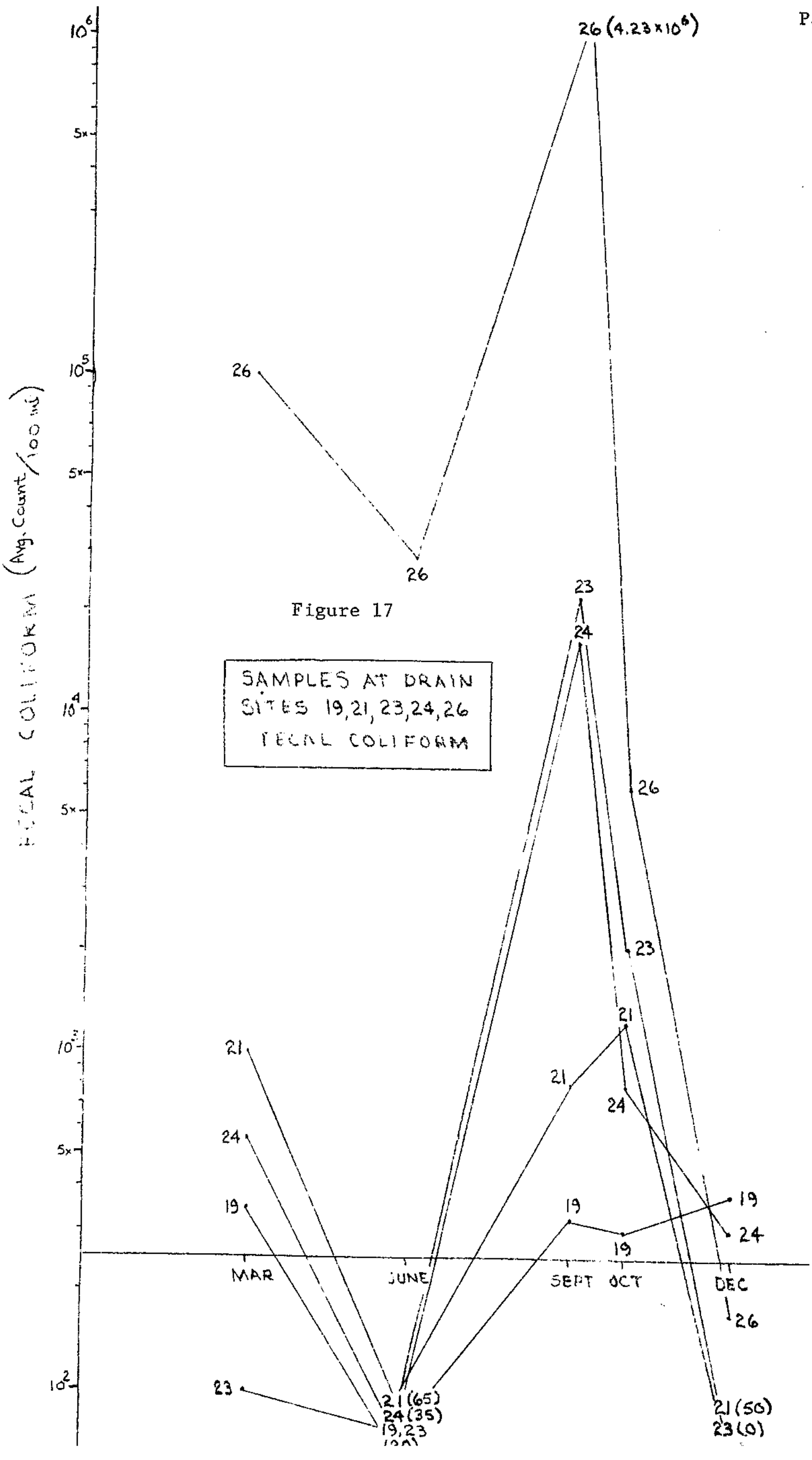

SAMPLES AT DRAIN SITES 19,21,23,24,26 FECAL COLIFORM
FECAL COLIFORM (Avg. Count/100 ml)
10^6
5×
10^5
5×
10^4
5×
10^3
5×
10^2
MAR
JUNE
SEPT
OCT
DEC
26 (4.23×10^6)
21 (65)
24 (35)
19,23
21 (50)
23 (0)

Figure 17

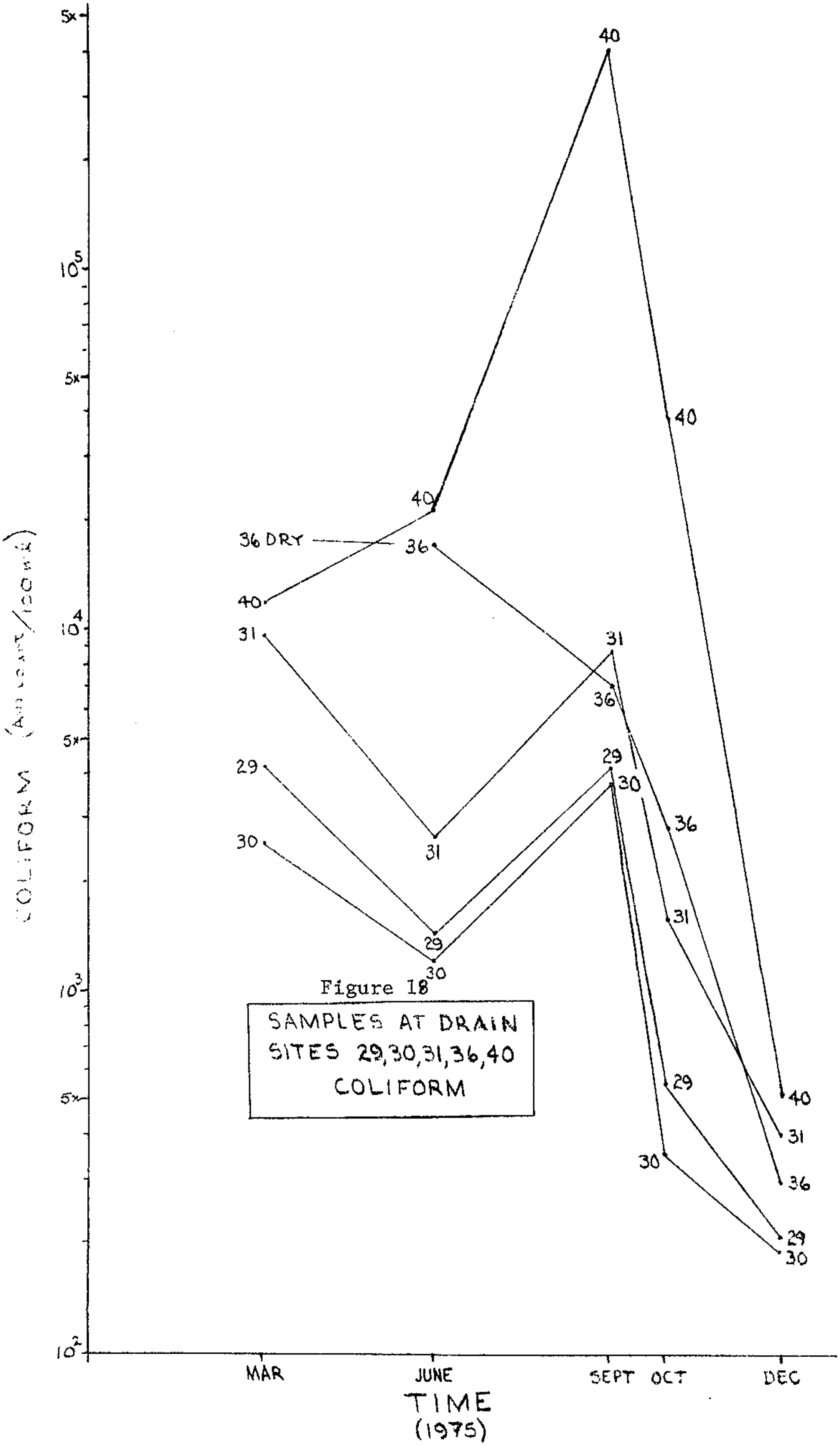


Figure 18

SAMPLES AT DRAIN SITES 29,30,31,36,40 COLIFORM

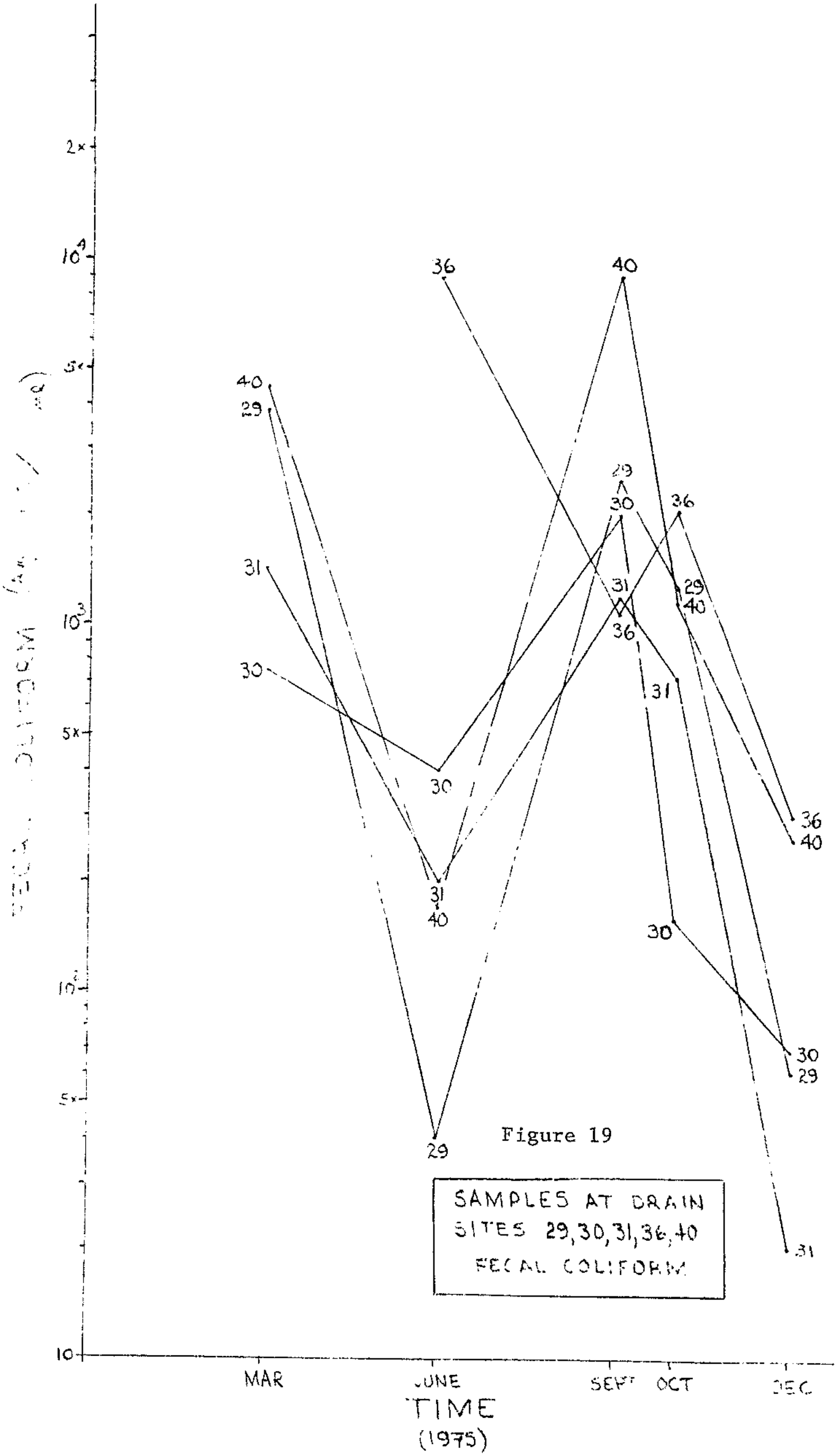
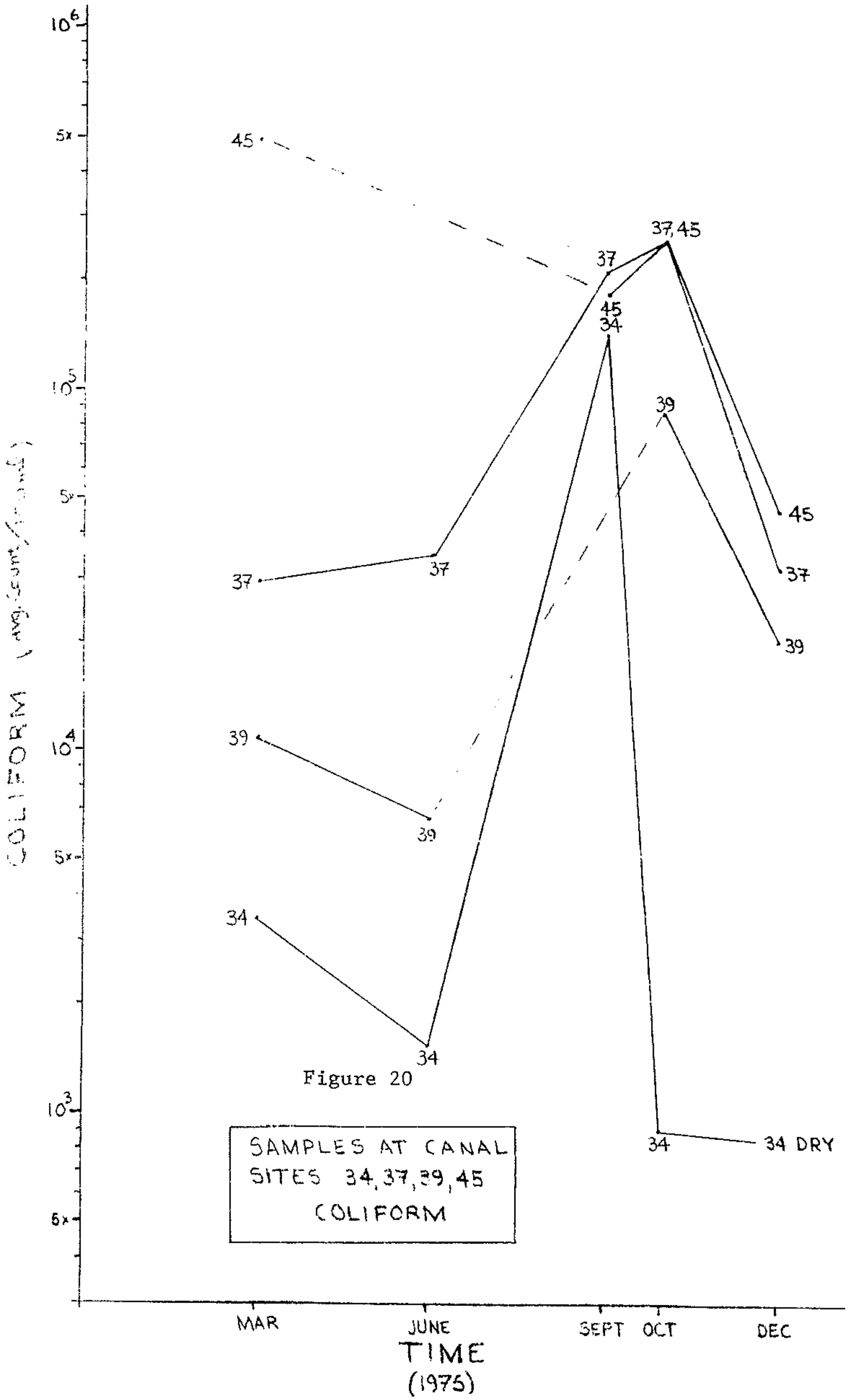

2×
10^4
5×
40
29
31
30
36
29
30
31
36
30
31
40
29
36
40
29
31
30
36
40
30
29
31
10^3
5×
10^2
5×
10
SAMPLES AT DRAIN
SITES 29,30,31,36,40
FECAL COLIFORM
MAR
JUNE
OCT
TIME
(1975)

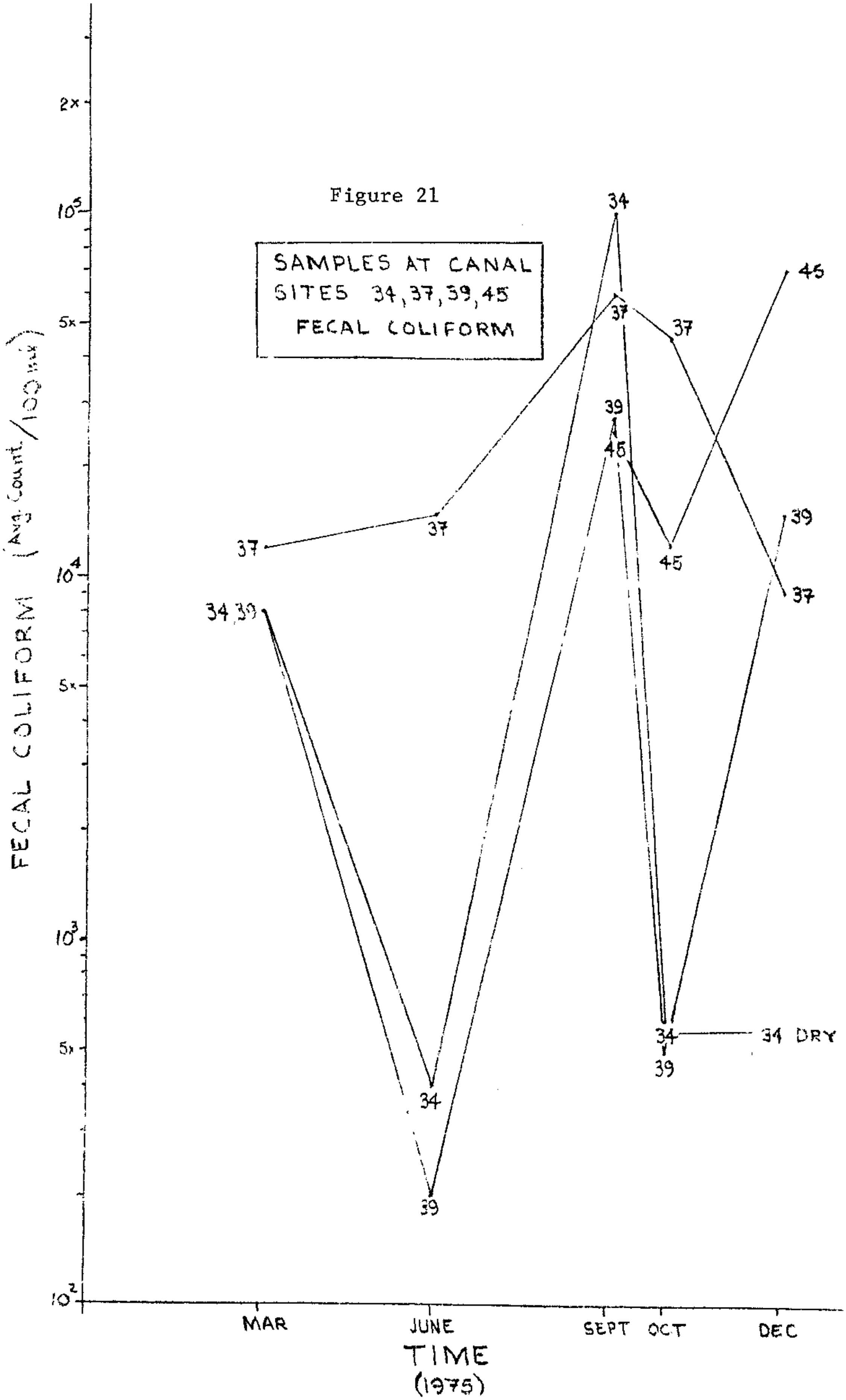
Figure 19



COLIFORM
10^6
5x
10^5
5x
10^4
5x
10^3
5x
45
37
39
34
37,45
34 DRY
MAR
JUNE
SEPT
OCT
DEC
TIME
(1975)
SAMPLES AT CANAL
SITES 34,37,39,45
COLIFORM

Figure 20

Figure 21


SAMPLES AT CANAL
SITES 34,37,39,45
FECAL COLIFORM
FECAL COLIFORM (Avg. Count/100 ml)
2x
10^5
5x
10^4
5x
10^3
5x
10^2
34
37
37
45
39
45
37
39
37
37
45
34,39
34 DRY
34
39
34
39
MAR
JUNE
SEPT
OCT
DEC
TIME
(1975)

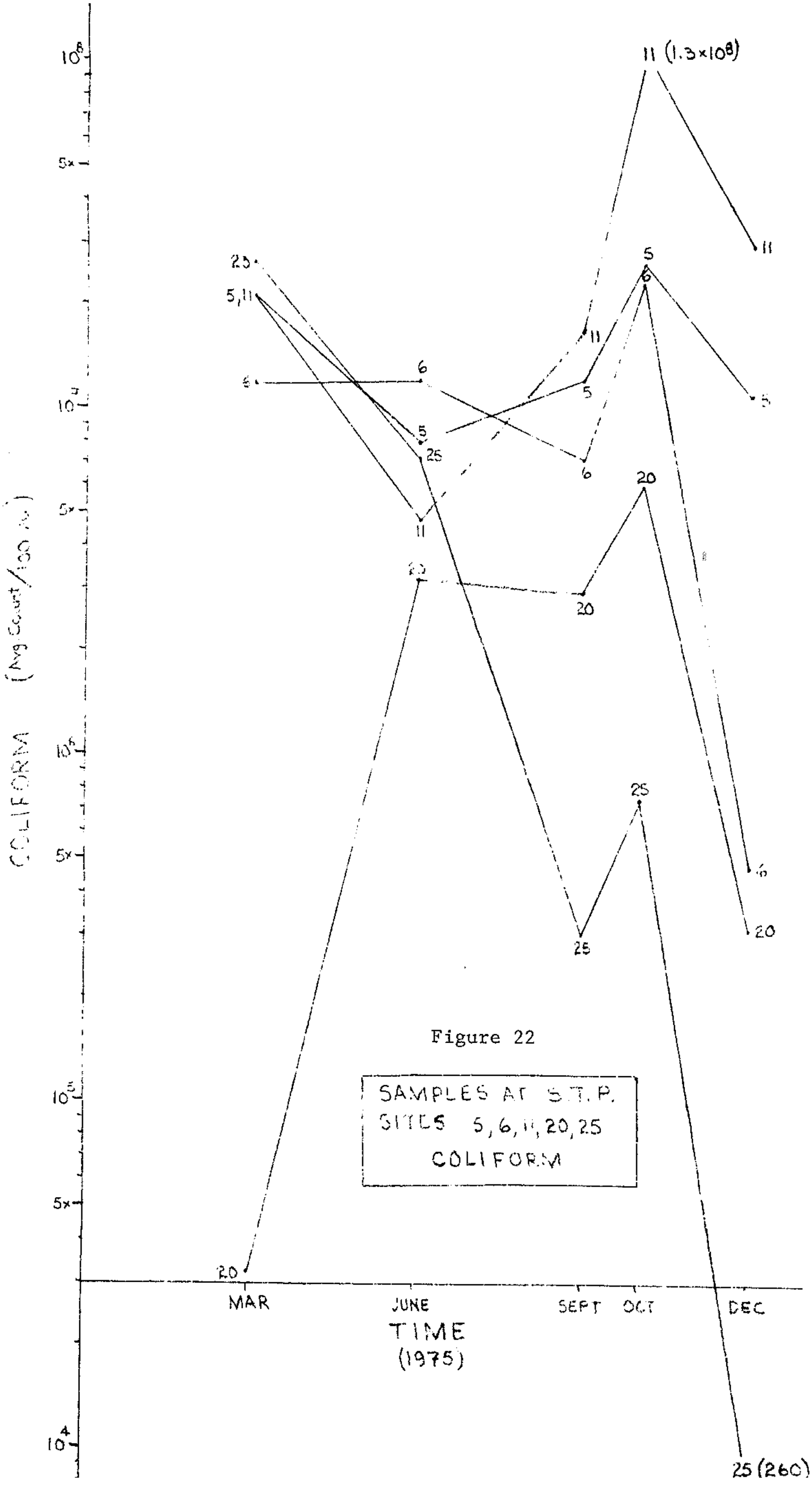

COLIFORM (Avg Count/100 ml)
TIME
(1975)
MAR
JUNE
SEPT
OCT
DEC
SAMPLES AT S.T.P.
SITES 5, 6, 11, 20, 25
COLIFORM
11 (1.3×10⁸)
25 (260)

Figure 22

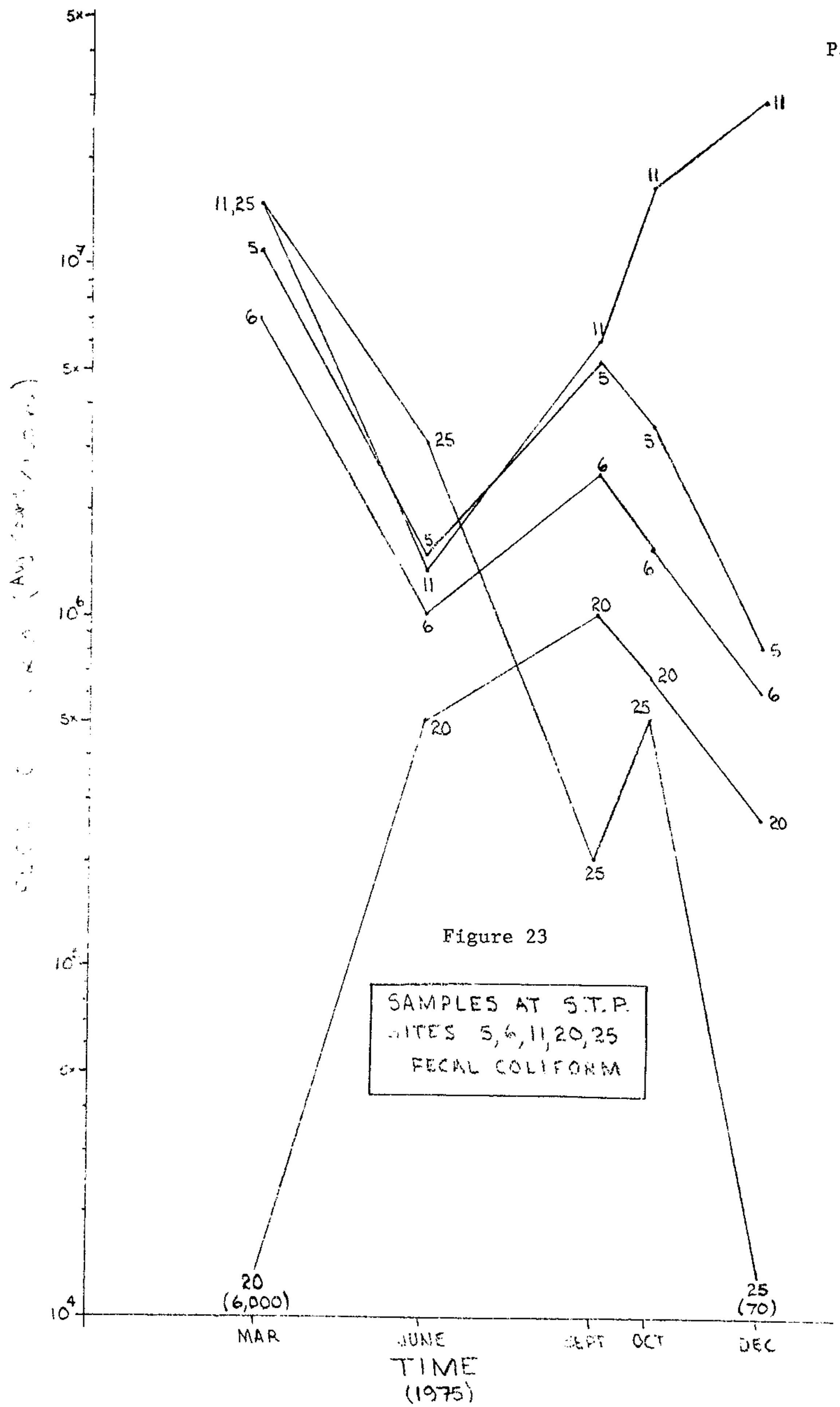

5x
10^7
5x
10^6
5x
10^5
5x
10^4
11,25
5
6
25
5
11
6
11
5
6
20
11
5
6
20
25
5
6
20
25
20
(6,000)
25
(70)
SAMPLES AT S.T.P.
SITES 5,6,11,20,25
FECAL COLIFORM
MAR
JUNE
SEPT
OCT
DEC
TIME
(1975)

Figure 23

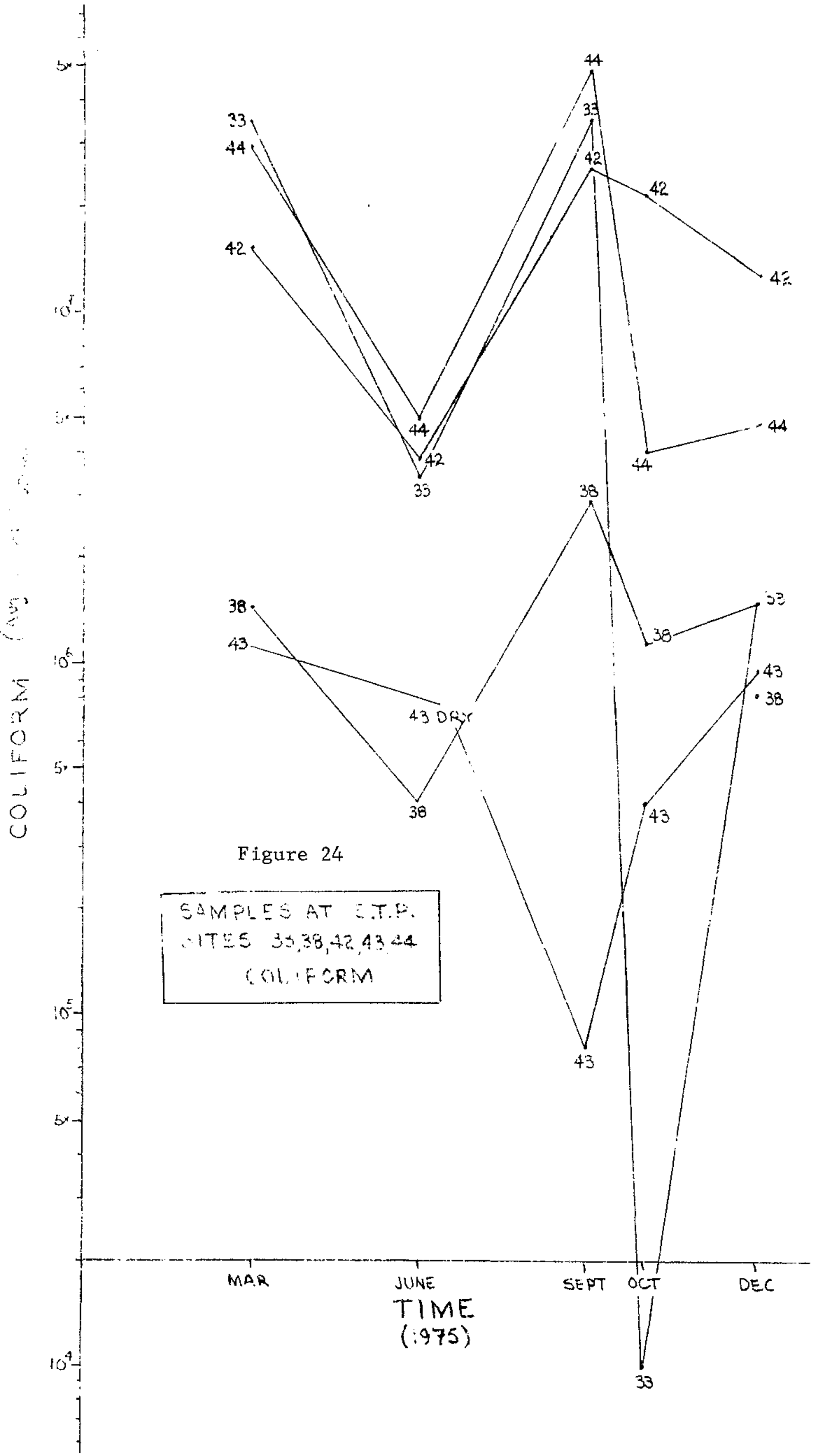
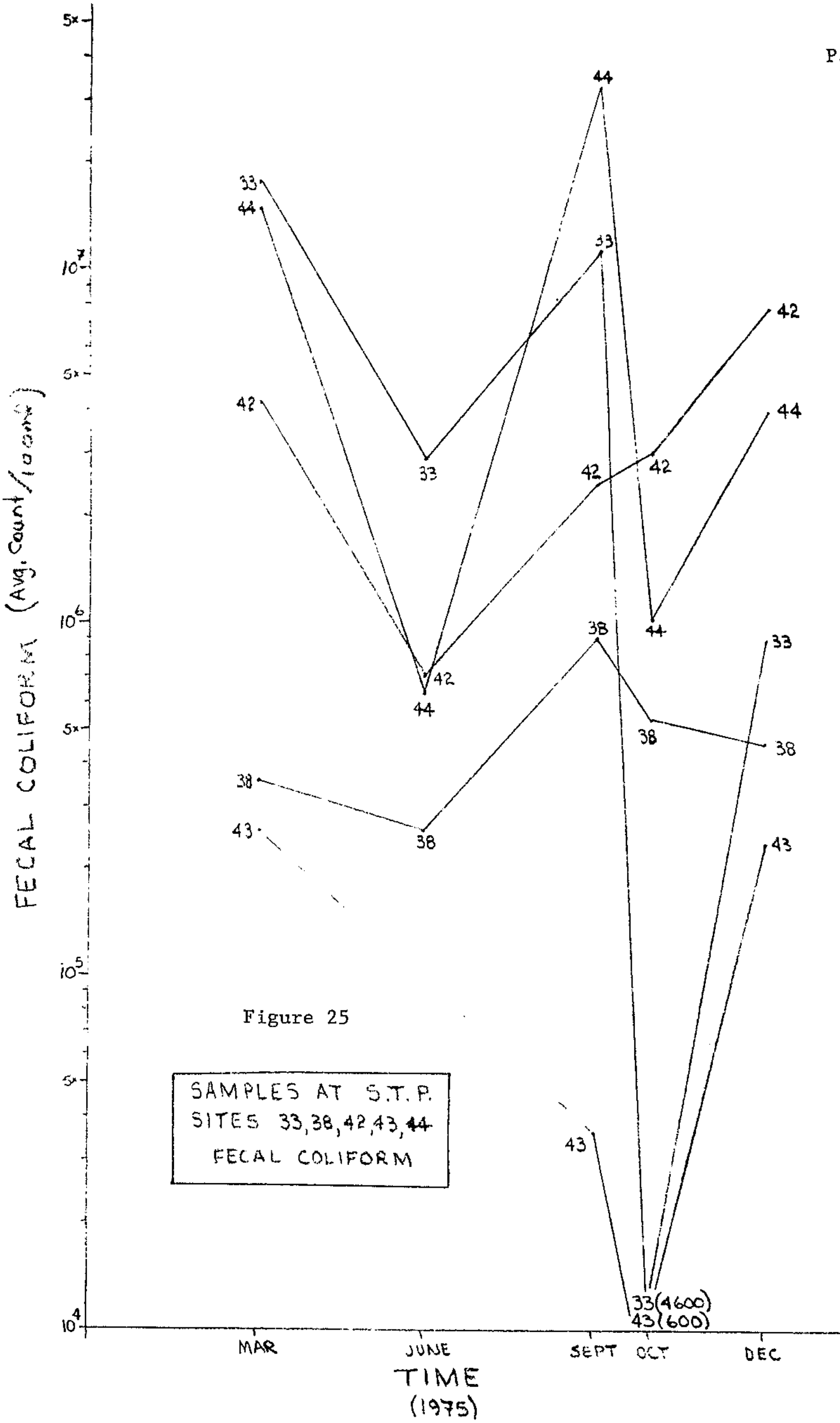


Figure 24



5×
10⁷
5×
10⁶
5×
10⁵
5×
10⁴
FECAL COLIFORM (Avg. Count/100 ml)
33
44
42
38
43
33
44
42
38
44
33
42
38
43
42
44
38
33(4600)
43(600)
42
44
33
38
43
SAMPLES AT S.T.P.
SITES 33,38,42,43,44
FECAL COLIFORM
MAR
JUNE
SEPT
OCT
DEC
TIME
(1975)

Figure 25

Figure 26

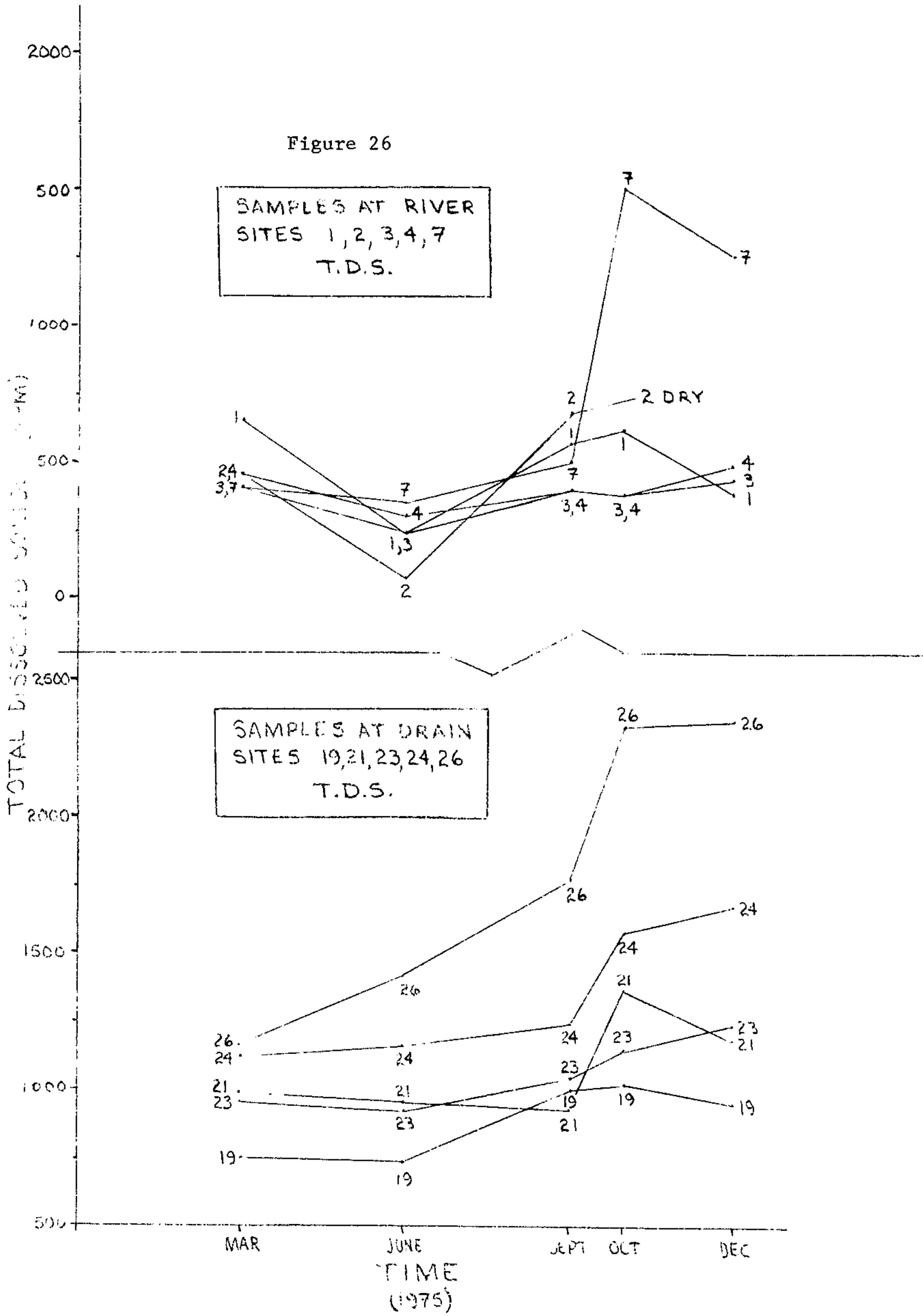

SAMPLES AT RIVER
SITES 1,2,3,4,7
T.D.S.
2 DRY
SAMPLES AT DRAIN
SITES 19,21,23,24,26
T.D.S.
2000
500
1000
500
0
2500
2000
1500
1000
500
MAR
JUNE
SEPT
OCT
DEC
TIME
(1975)
TOTAL DISSOLVED SOLIDS

Figure 27

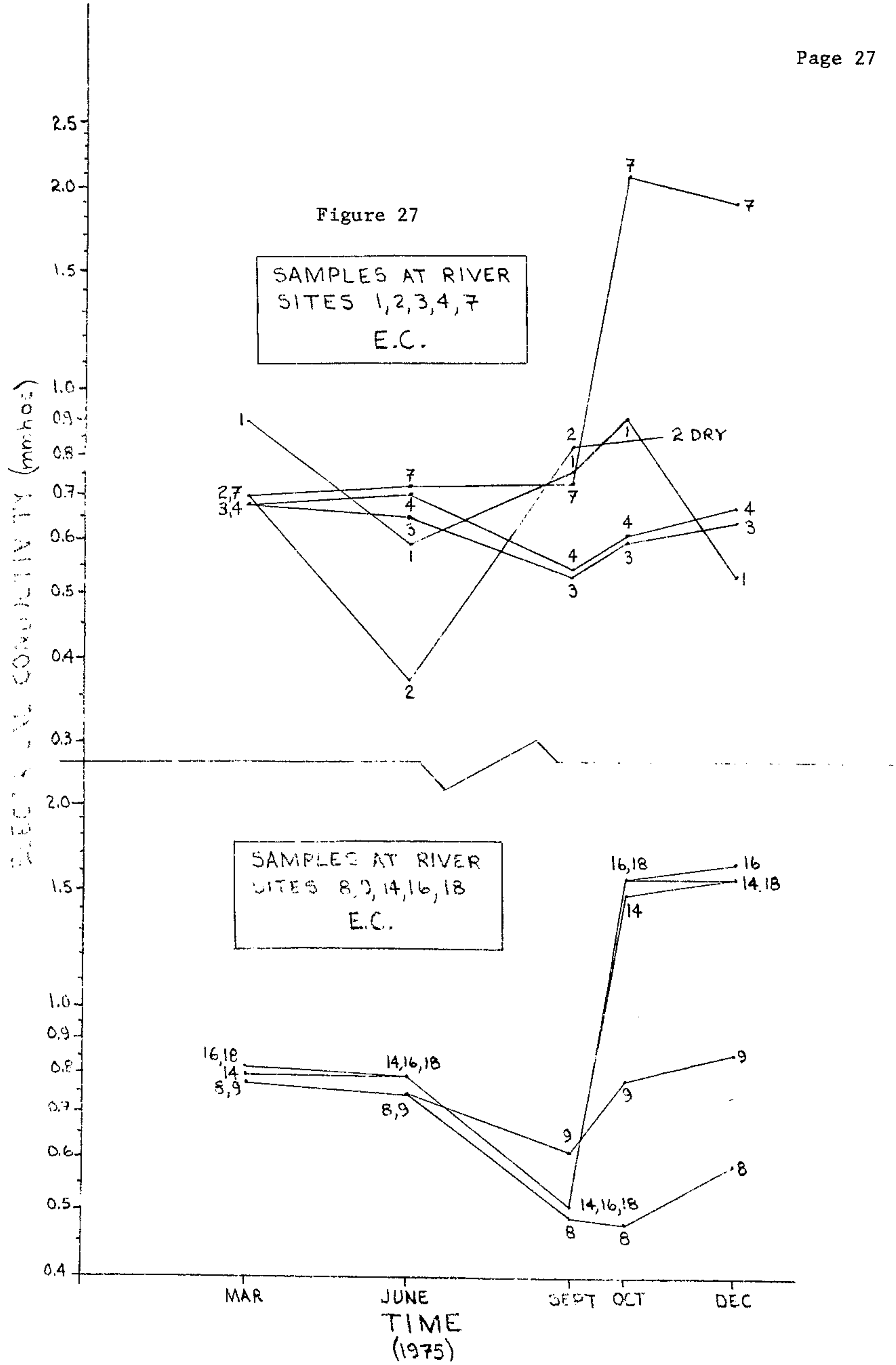

SAMPLES AT RIVER SITES 1,2,3,4,7
E.C.
SAMPLES AT RIVER SITES 8,9,14,16,18
E.C.
2 DRY
2.5
2.0
1.5
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
MAR
JUNE
SEPT
OCT
DEC
TIME
(1975)

Figure 28

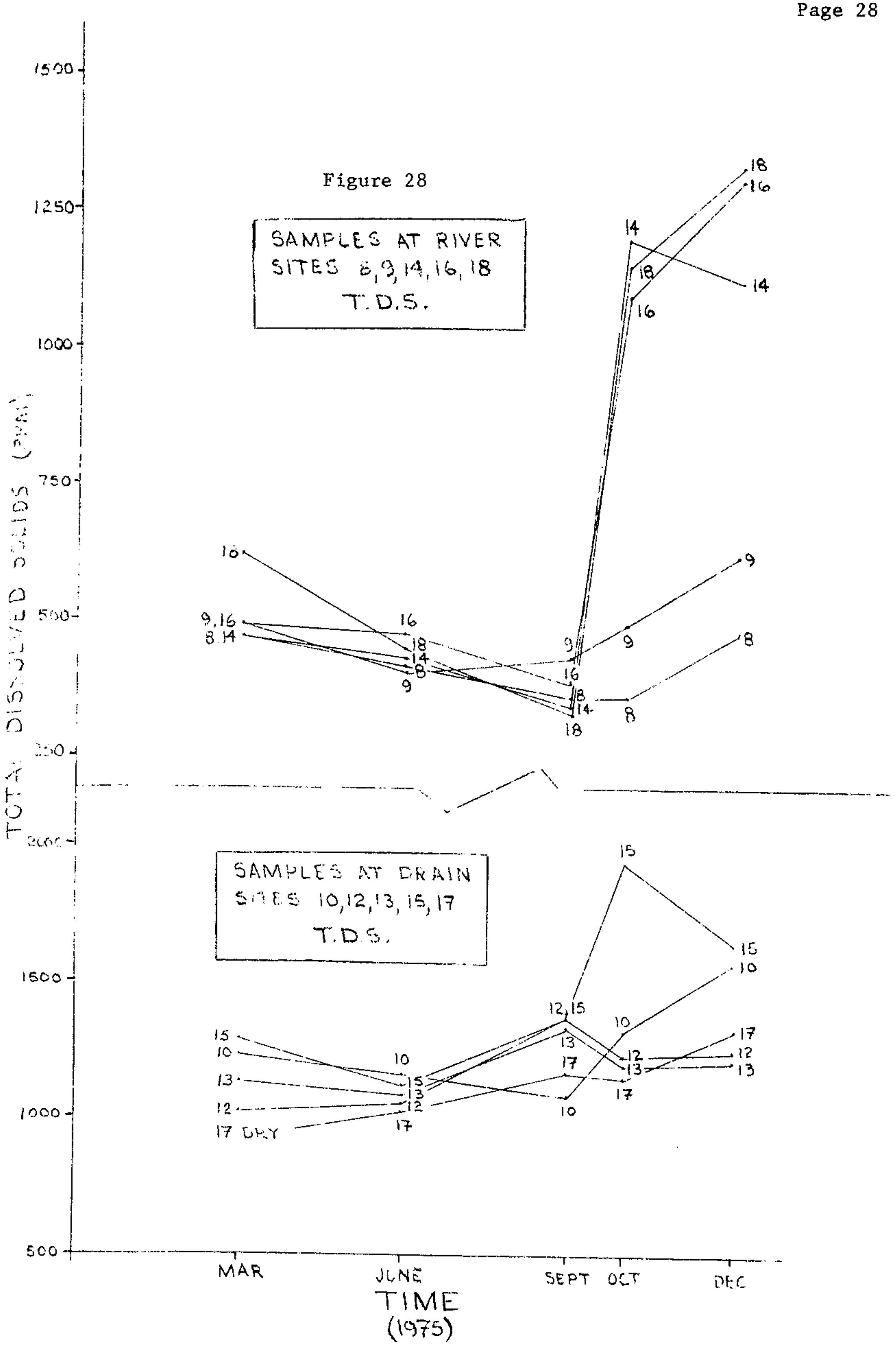

SAMPLES AT RIVER SITES 8,9,14,16,18 T.D.S.
SAMPLES AT DRAIN SITES 10,12,13,15,17 T.D.S.
TOTAL DISSOLVED SOLIDS (PPM)
TIME (1975)
MAR
JUNE
SEPT
OCT
DEC
1500
1250
1000
750
500
250
2000
1500
1000
500
17 DRY

Figure 29

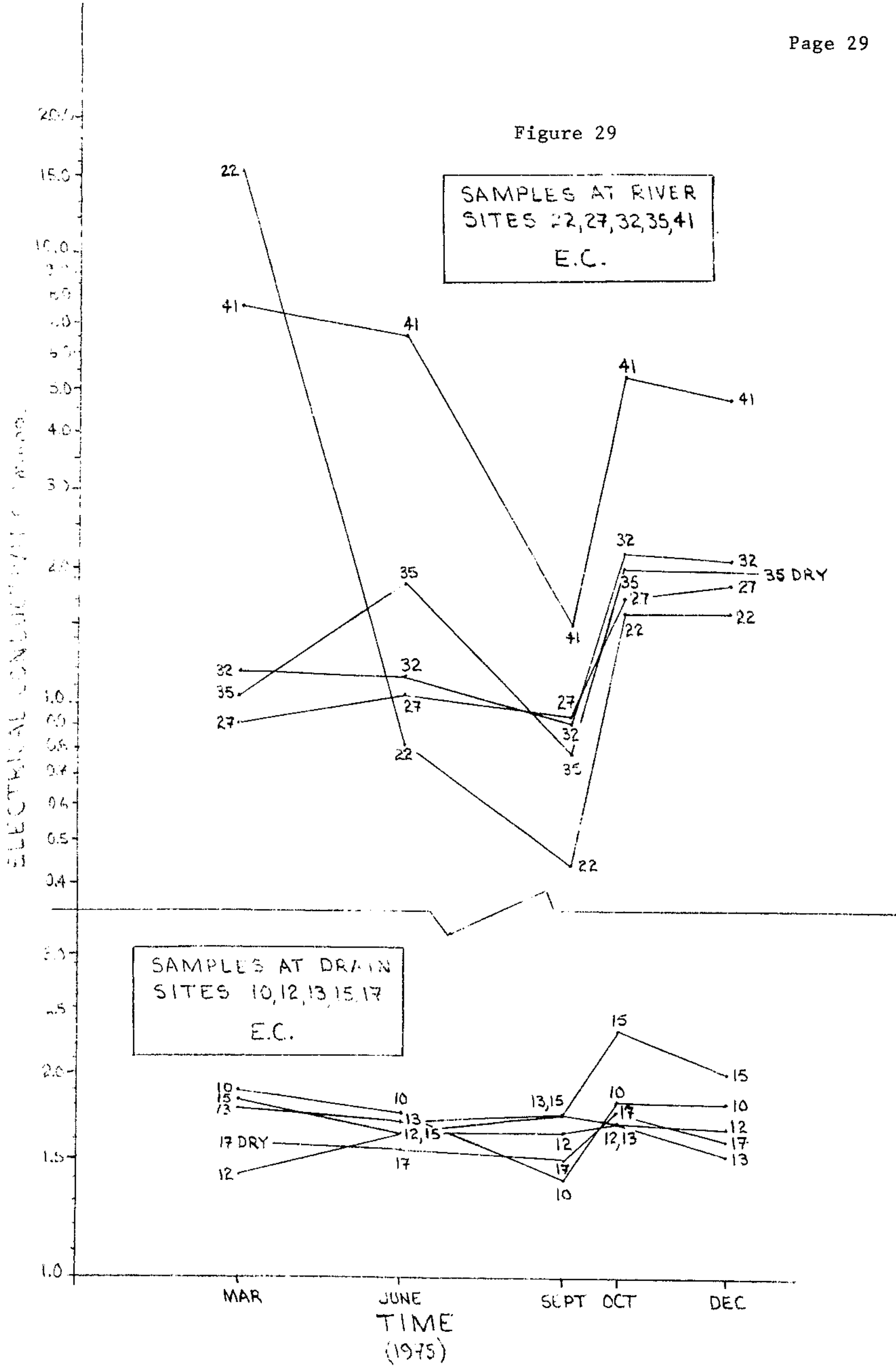
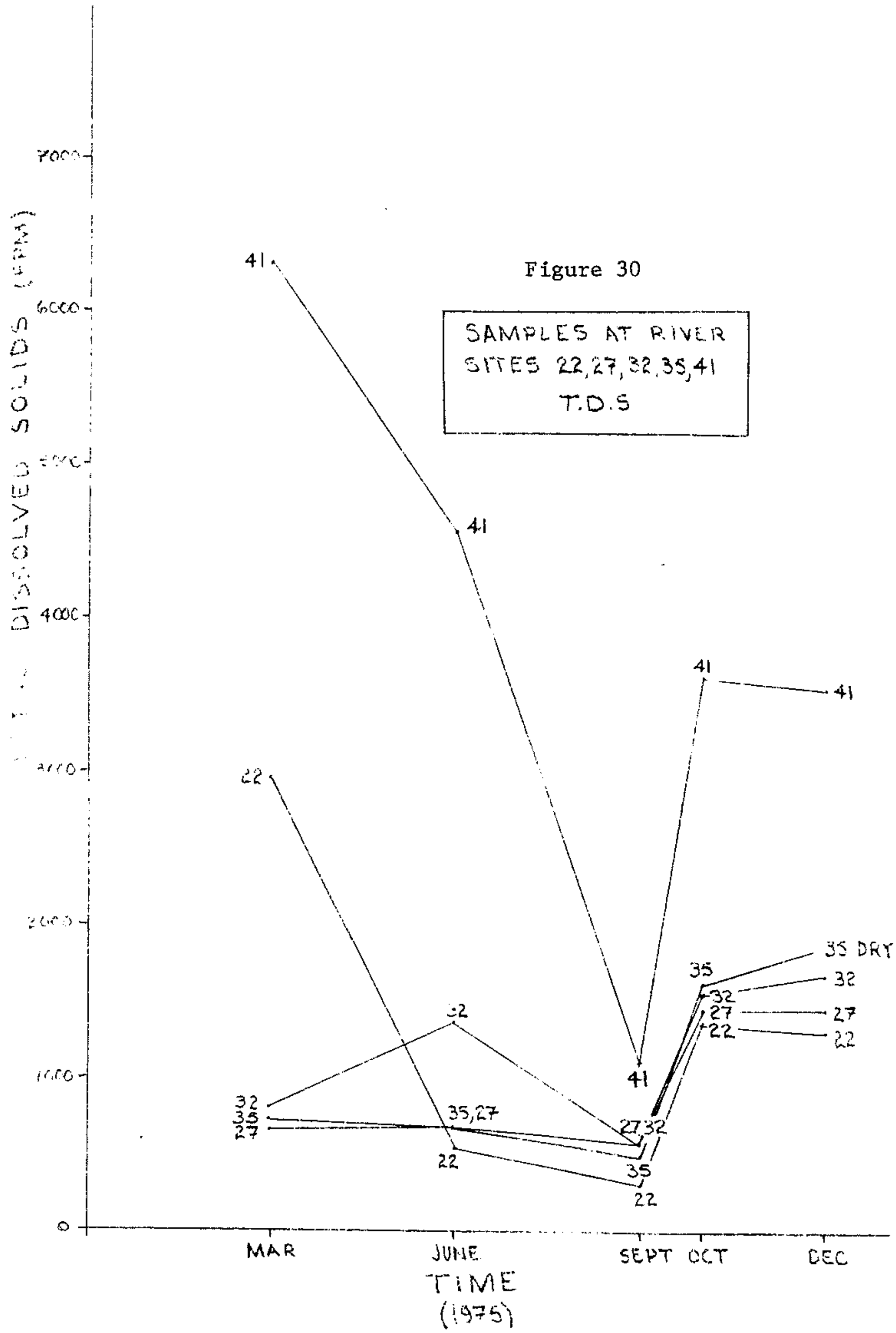

SAMPLES AT RIVER SITES 22,27,32,35,41
E.C.
SAMPLES AT DRAIN SITES 10,12,13,15,17
E.C.
35 DRY
17 DRY
MAR
JUNE
SEPT
OCT
DEC
TIME
(1975)

Figure 30


SAMPLES AT RIVER
SITES 22,27,32,35,41
T.D.S
DISSOLVED SOLIDS (PPM)
7000
6000
4000
2000
1000
0
MAR
JUNE
SEPT
OCT
DEC
TIME
(1975)
41
22
32
35
27
35,27
27 32
35 DRY

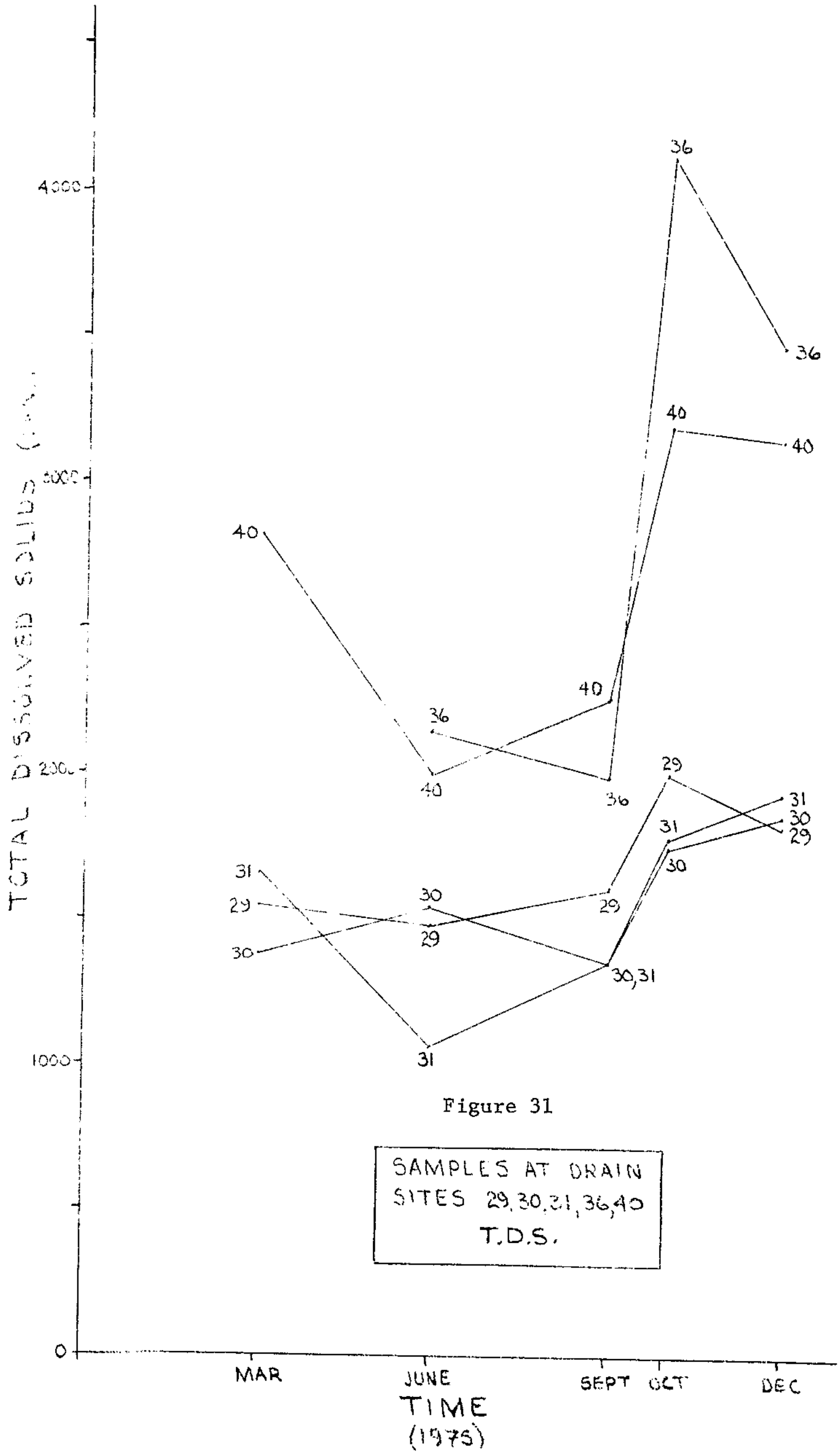


Figure 31

SAMPLES AT DRAIN SITES 29,30,31,36,40 T.D.S.

Figure 32

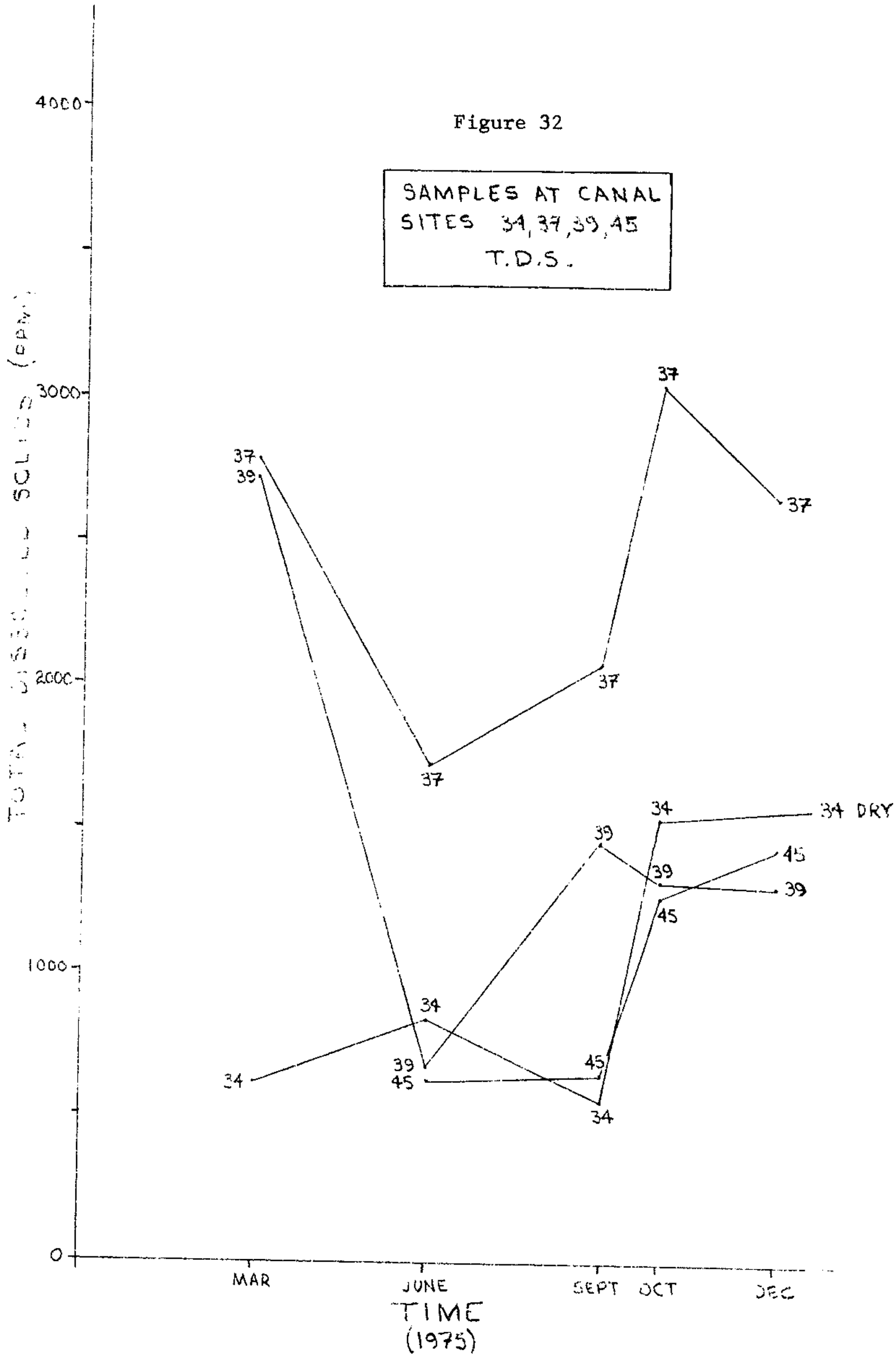

SAMPLES AT CANAL
SITES 34,37,39,45
T.D.S.
4000
3000
2000
1000
0
MAR
JUNE
SEPT
OCT
DEC
TIME
(1975)
34 DRY

Figure 33

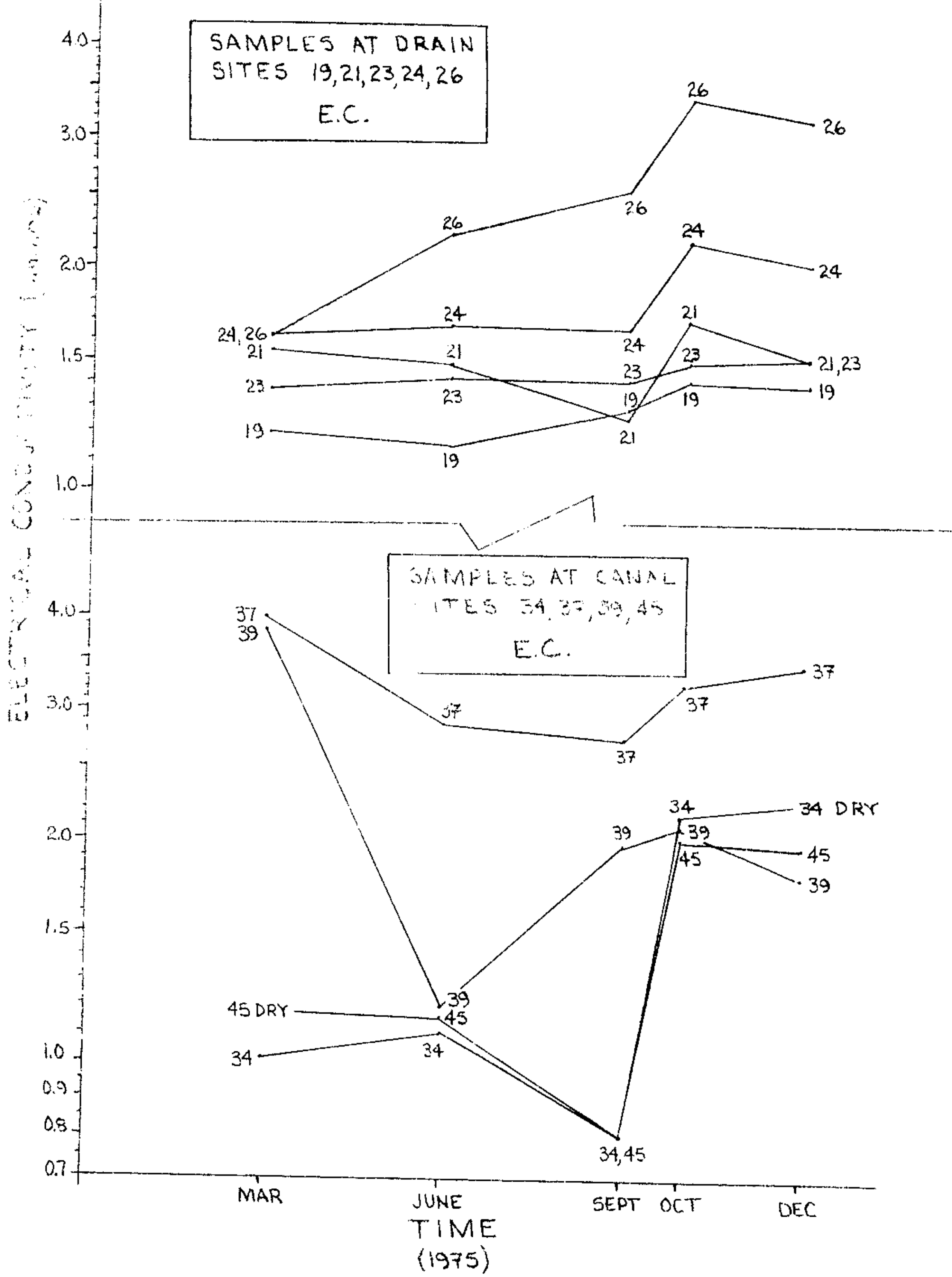

SAMPLES AT DRAIN SITES 19,21,23,24,26
E.C.
SAMPLES AT CANAL SITES 34,37,39,45
E.C.
4.0
3.0
2.0
1.5
1.0
0.9
0.8
0.7
24,26
21
23
19
26
24
34 DRY
45 DRY
21,23
34,45
MAR
JUNE
SEPT
OCT
DEC
TIME
(1975)

Figure 34

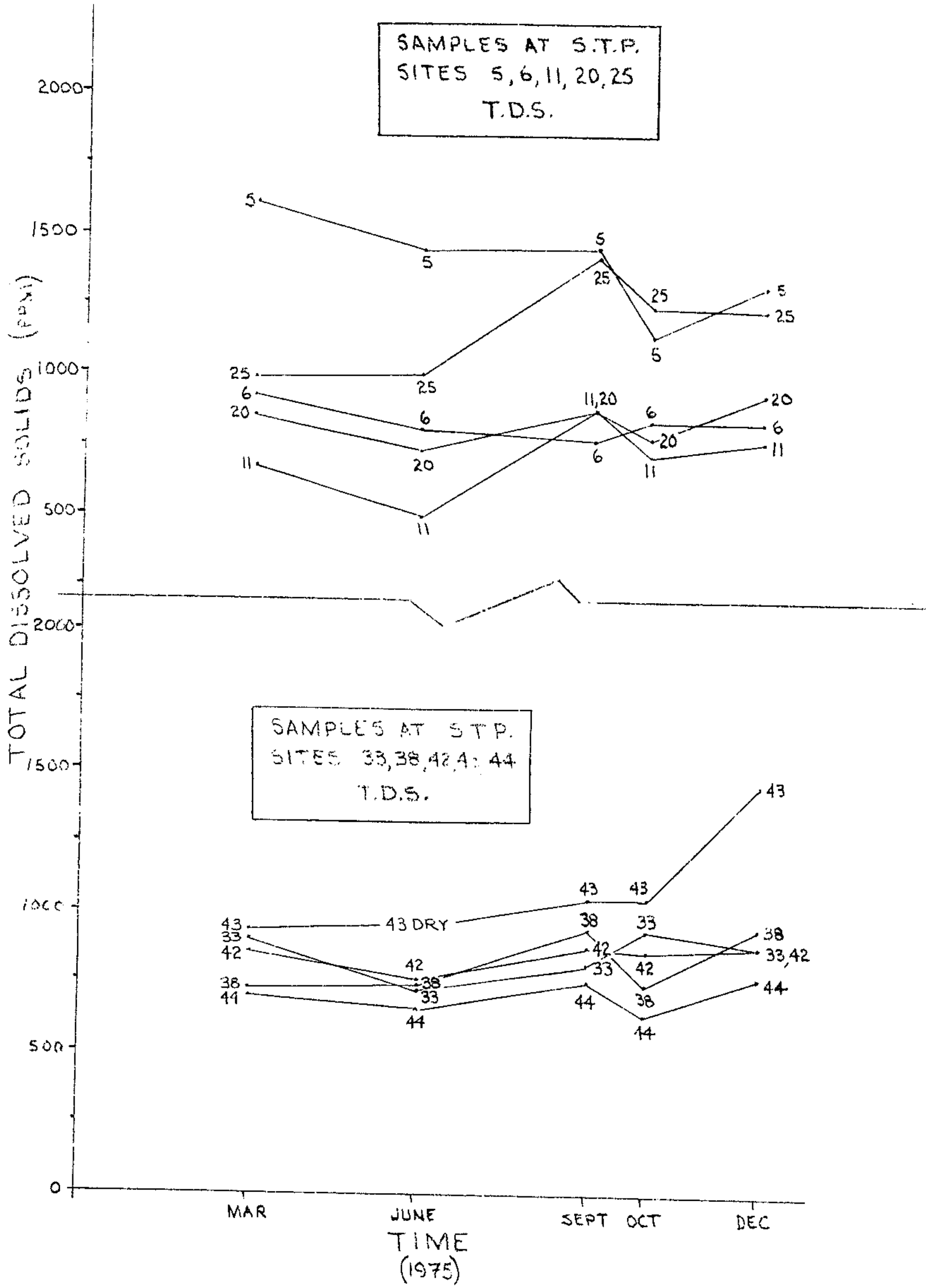

SAMPLES AT S.T.P.
SITES 5, 6, 11, 20, 25
T.D.S.
SAMPLES AT S.T.P.
SITES 33,38,42,43 & 44
T.D.S.
TOTAL DISSOLVED SOLIDS (PPM)
2000
1500
1000
500
0
43 DRY
MAR
JUNE
SEPT
OCT
DEC
TIME
(1975)

Figure 35

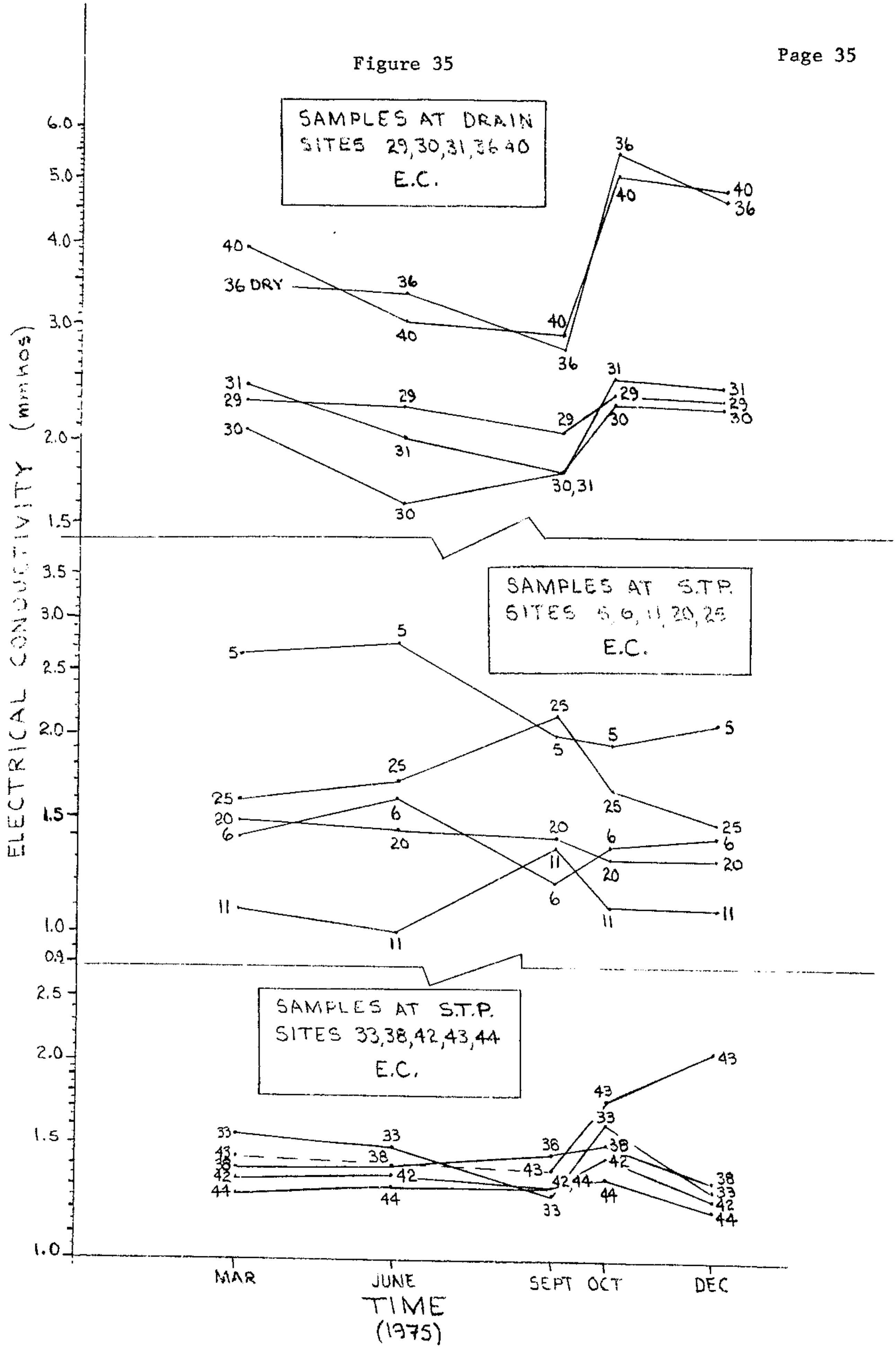
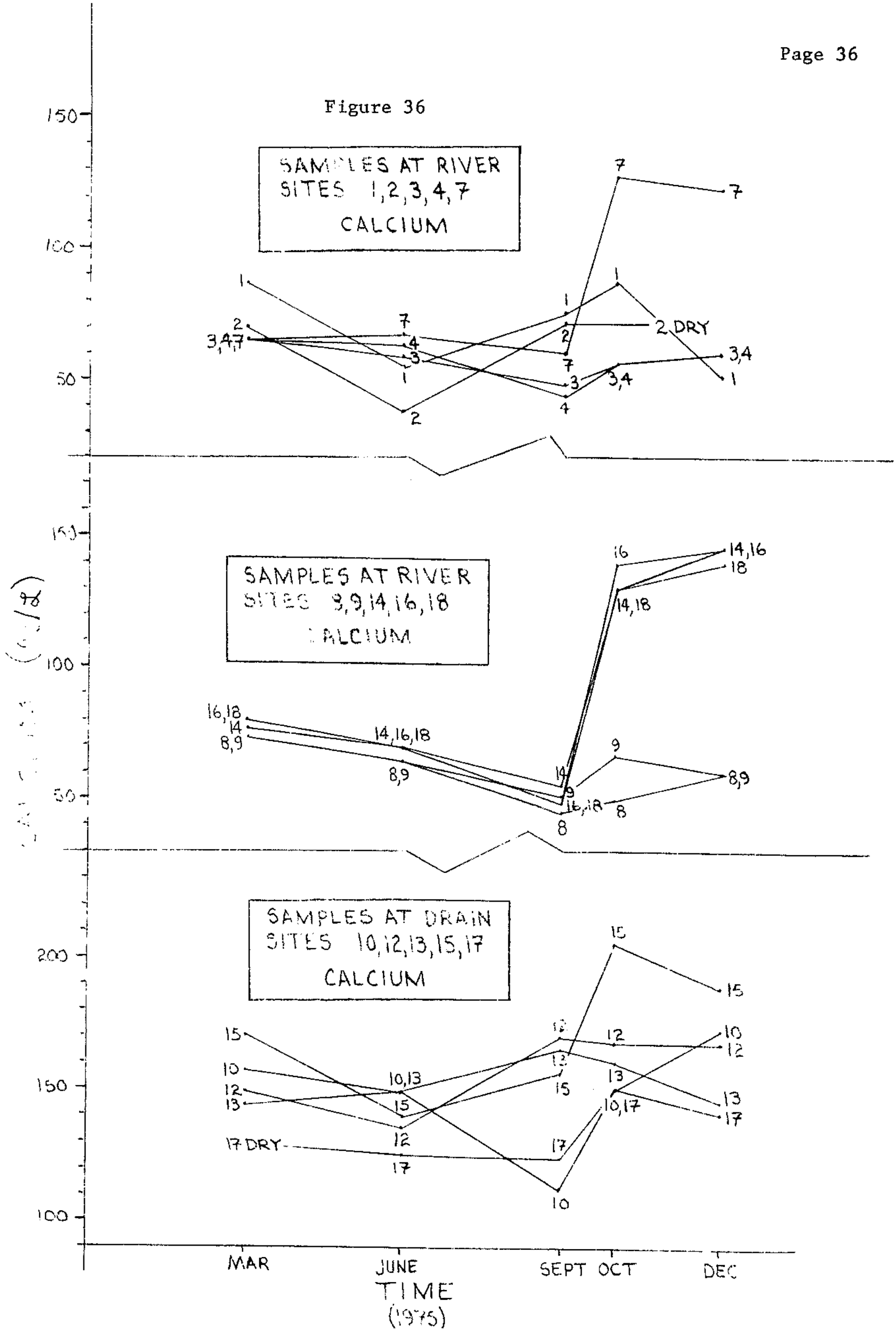

SAMPLES AT DRAIN
SITES 29,30,31,36 40
E.C.
SAMPLES AT S.T.P.
SITES 5,6,11,20,25
E.C.
SAMPLES AT S.T.P.
SITES 33,38,42,43,44
E.C.
ELECTRICAL CONDUCTIVITY (mmhos)
36 DRY
MAR
JUNE
SEPT
OCT
DEC
TIME
(1975)

Figure 36



SAMPLES AT RIVER SITES 1,2,3,4,7 CALCIUM
SAMPLES AT RIVER SITES 8,9,14,16,18 CALCIUM
SAMPLES AT DRAIN SITES 10,12,13,15,17 CALCIUM
2 DRY
17 DRY
150
100
50
200
MAR
JUNE
SEPT
OCT
DEC
TIME
(1975)

Figure 37

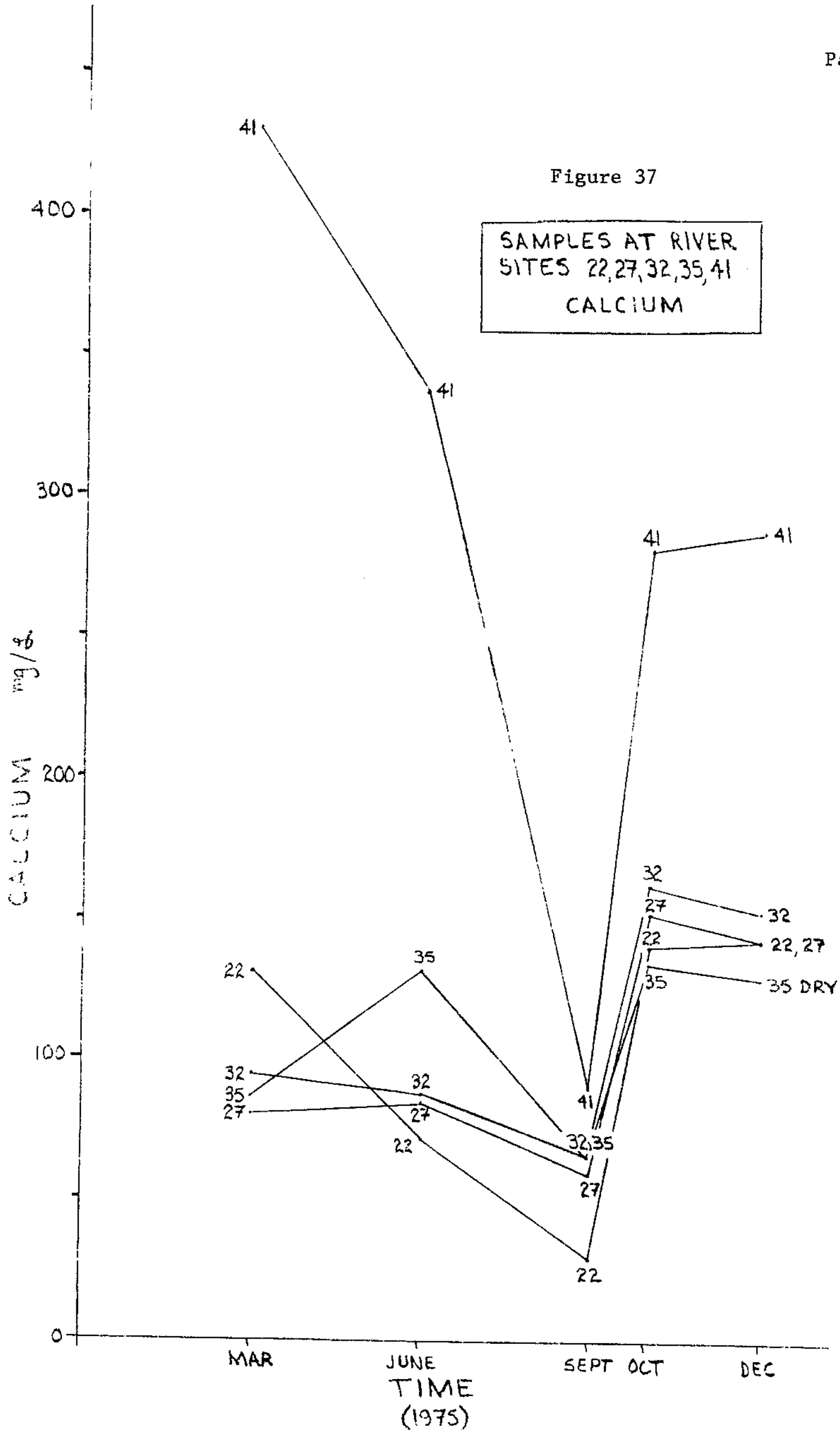

SAMPLES AT RIVER
SITES 22,27,32,35,41
CALCIUM
CALCIUM mg/l
400
300
200
100
0
MAR
JUNE
SEPT
OCT
DEC
TIME
(1975)
41
22
35
32
27
35 DRY
22, 27

Figure 38

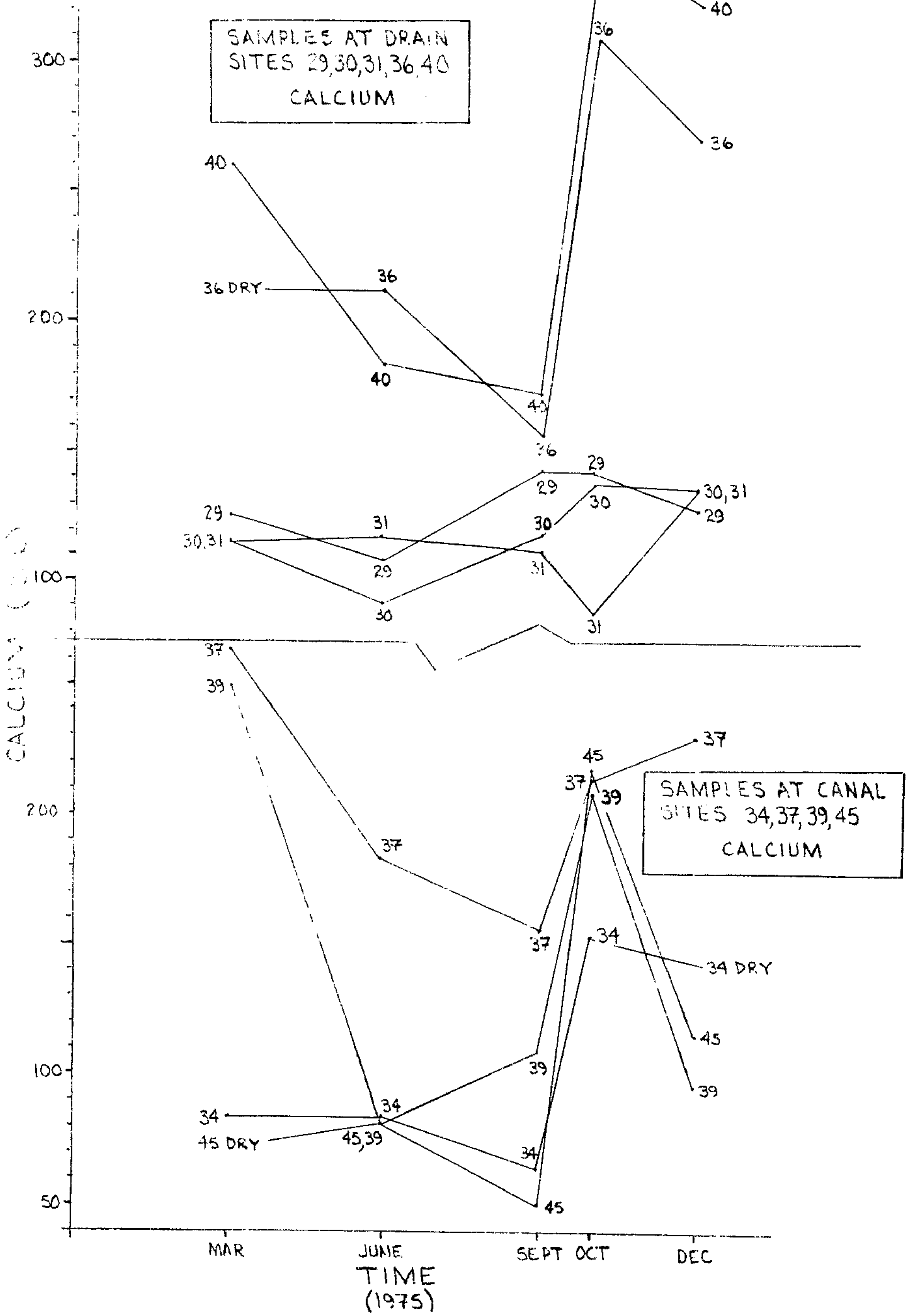

SAMPLES AT DRAIN SITES 29,30,31,36,40
CALCIUM
SAMPLES AT CANAL SITES 34,37,39,45
CALCIUM
300
200
100
200
100
50
36 DRY
34 DRY
45 DRY
30,31
45,39
MAR
JUNE
SEPT
OCT
DEC
TIME
(1975)

Figure 39

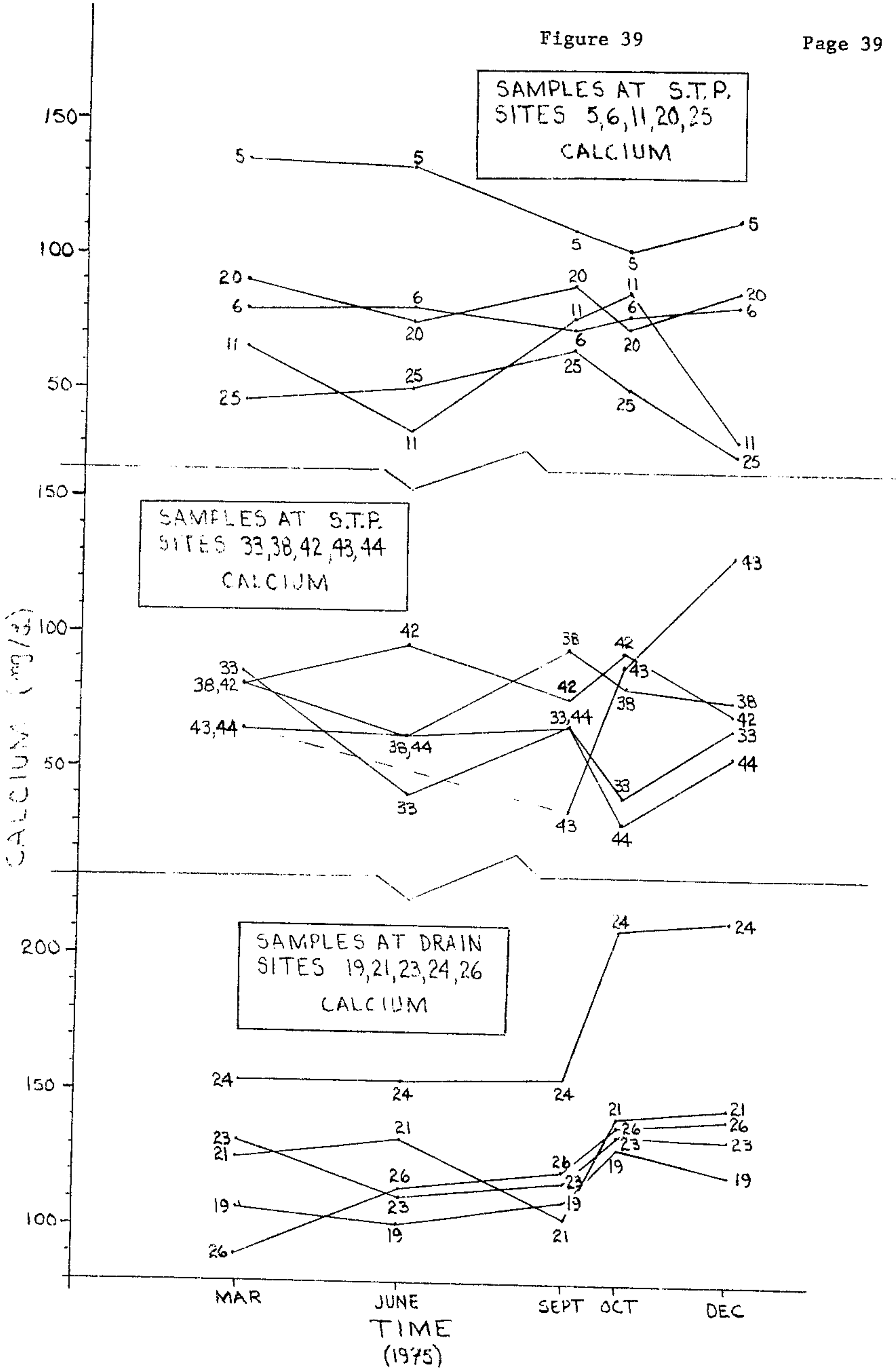
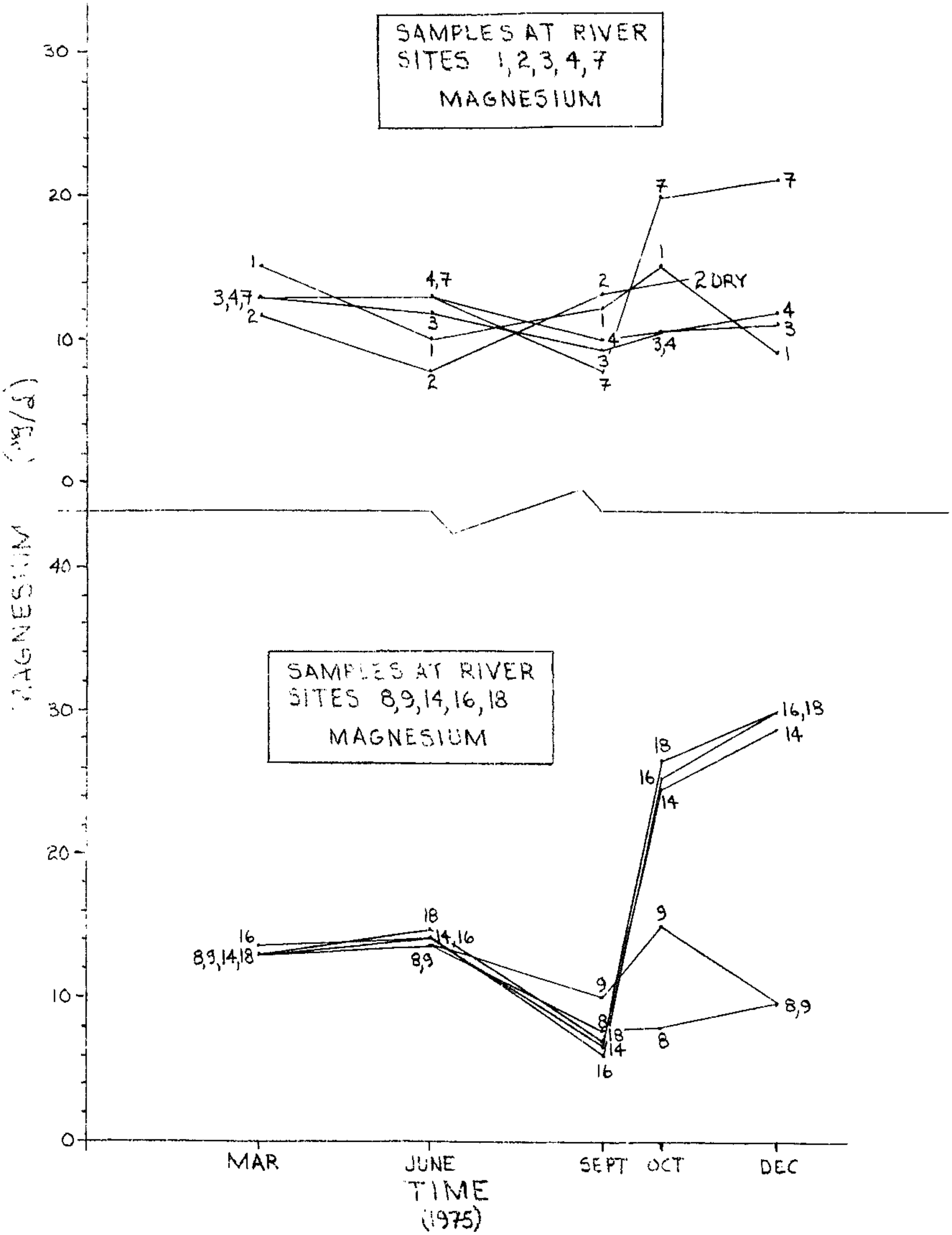

SAMPLES AT S.T.P.
SITES 5,6,11,20,25
CALCIUM
SAMPLES AT S.T.P.
SITES 33,38,42,43,44
CALCIUM
SAMPLES AT DRAIN
SITES 19,21,23,24,26
CALCIUM
CALCIUM (mg/l)
150
100
50
200
MAR
JUNE
SEPT
OCT
DEC
TIME
(1975)

Figure 40


SAMPLES AT RIVER SITES 1,2,3,4,7
MAGNESIUM
SAMPLES AT RIVER SITES 8,9,14,16,18
MAGNESIUM
MAGNESIUM (mg/l)
2 DRY
MAR
JUNE
SEPT
OCT
DEC
TIME
(1975)

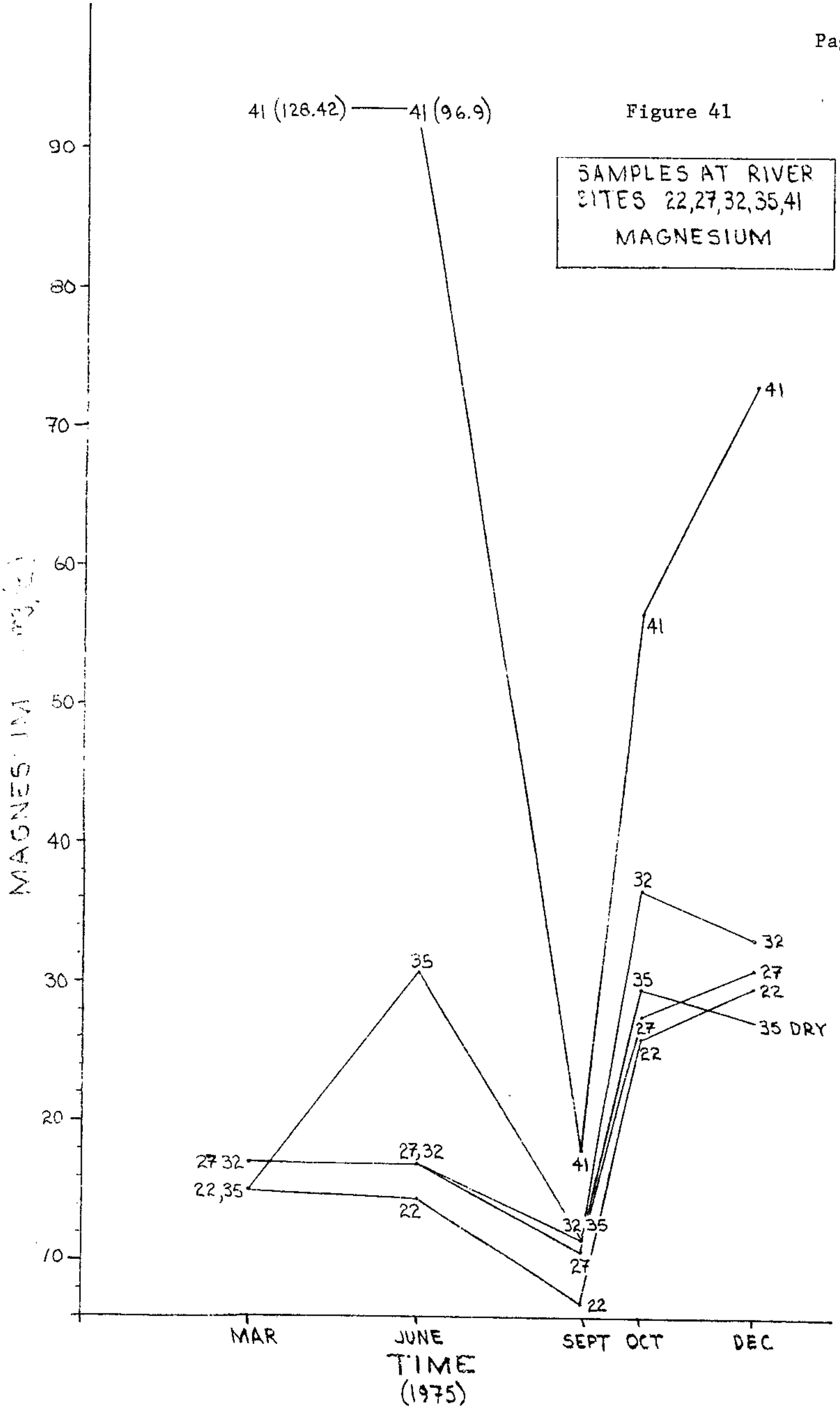
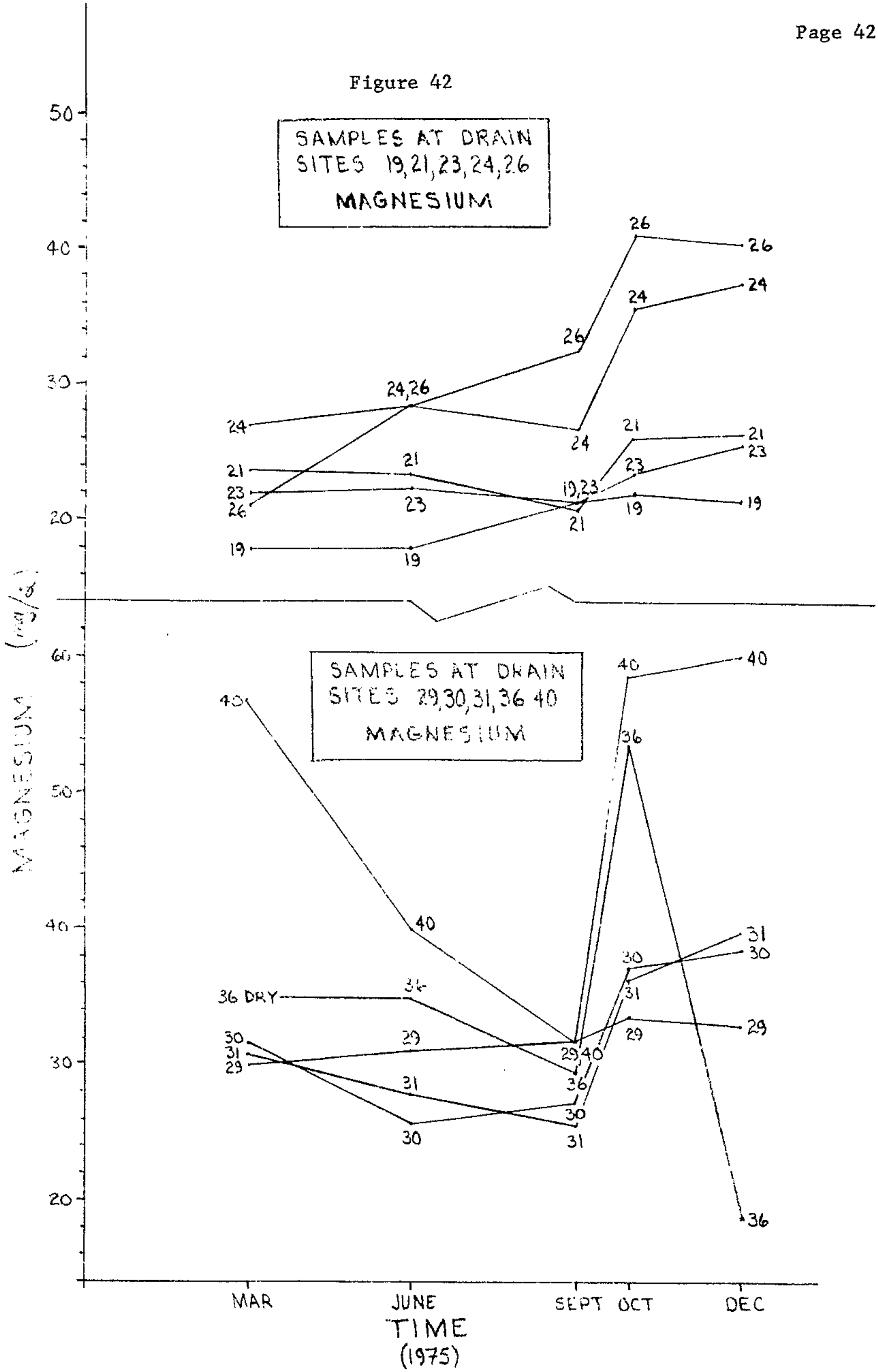

SAMPLES AT RIVER SITES 22,27,32,35,41
MAGNESIUM
41 (128.42)
41 (96.9)
90
80
70
60
50
40
30
20
10
MAGNES IM
41
41
41
32
32
35
27
22
35 DRY
27
22
35
27,32
27 32
22,35
22
32,35
27
22
MAR
JUNE
SEPT
OCT
DEC
TIME
(1975)

Figure 41

Figure 42



SAMPLES AT DRAIN SITES 19,21,23,24,26 MAGNESIUM
SAMPLES AT DRAIN SITES 29,30,31,36 40 MAGNESIUM
MAGNESIUM (mg/l)
36 DRY
MAR
JUNE
SEPT
OCT
DEC
TIME (1975)

Figure 43

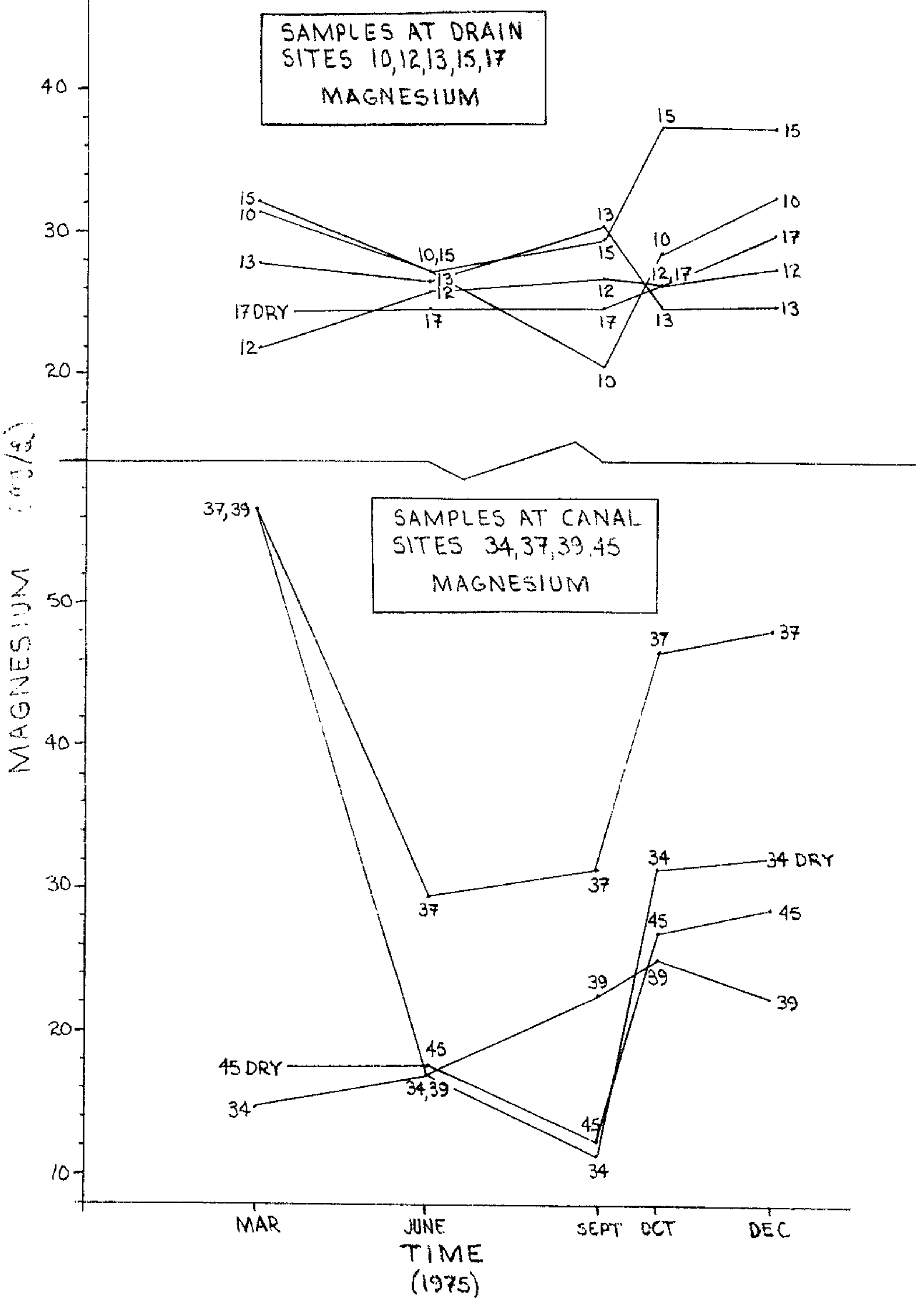

SAMPLES AT DRAIN SITES 10,12,13,15,17 MAGNESIUM
SAMPLES AT CANAL SITES 34,37,39,45 MAGNESIUM
MAGNESIUM (mg/l)
17 DRY
45 DRY
34 DRY
10
20
30
40
50
MAR
JUNE
SEPT
OCT
DEC
TIME (1975)

Figure 44

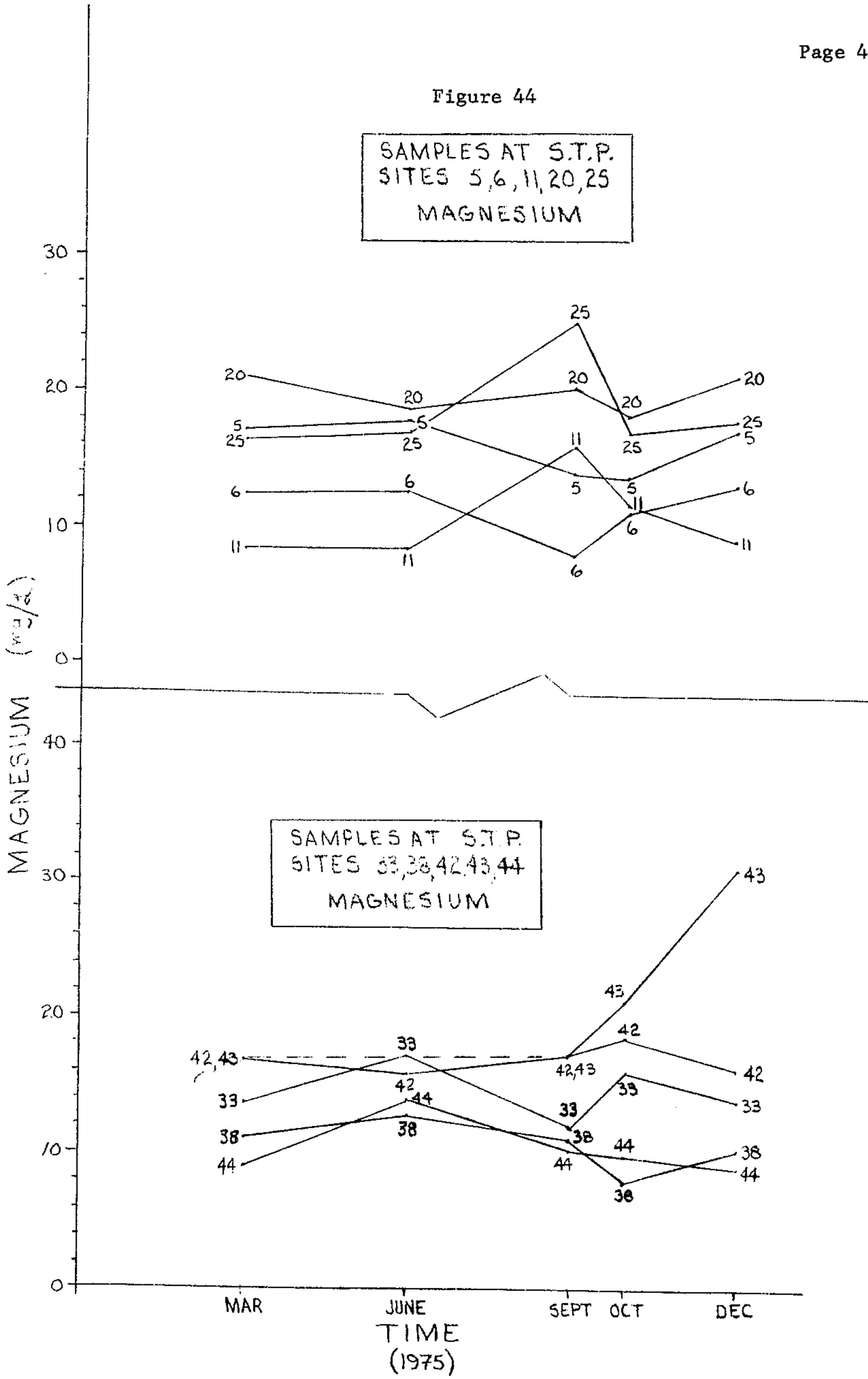
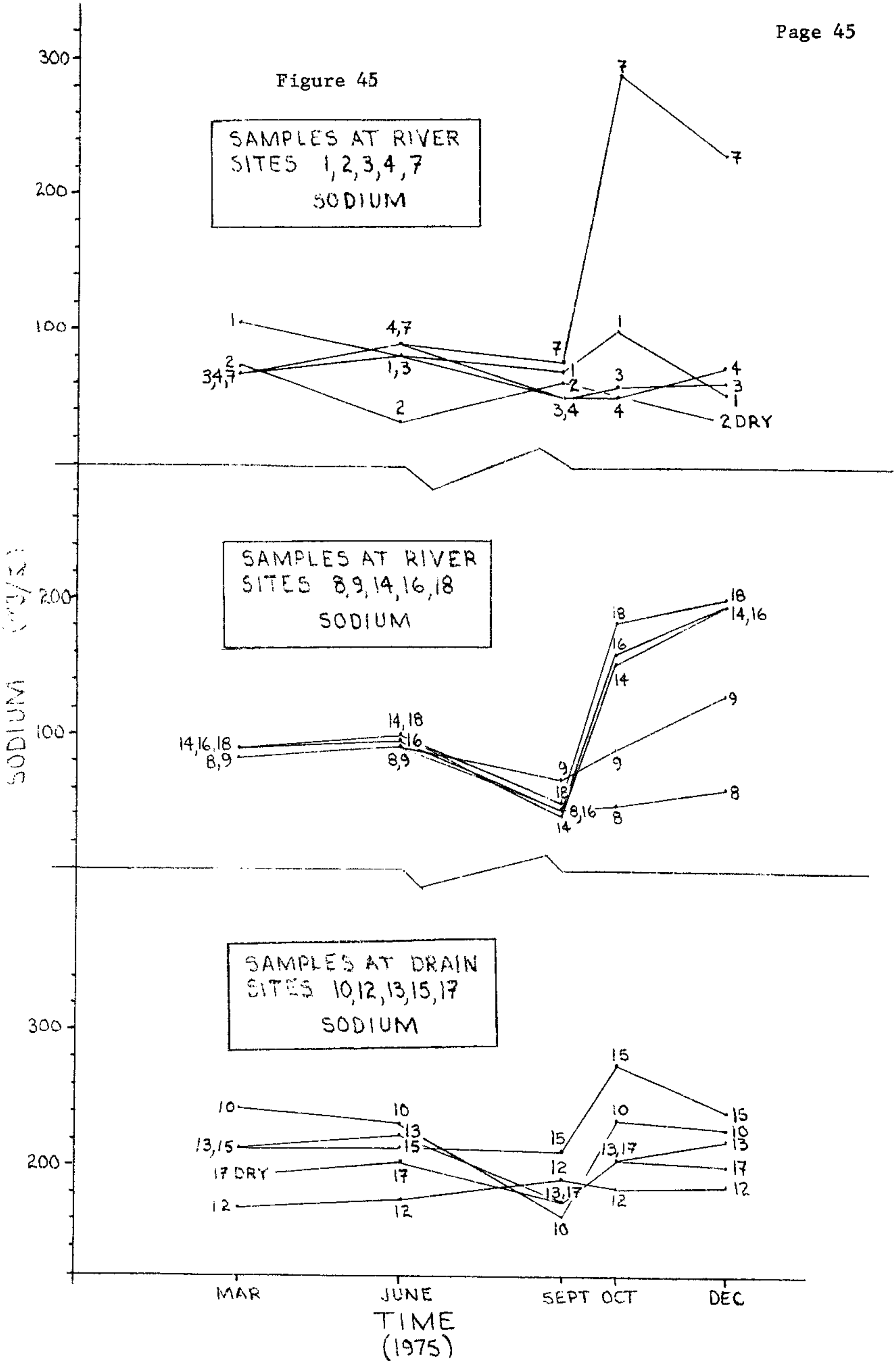
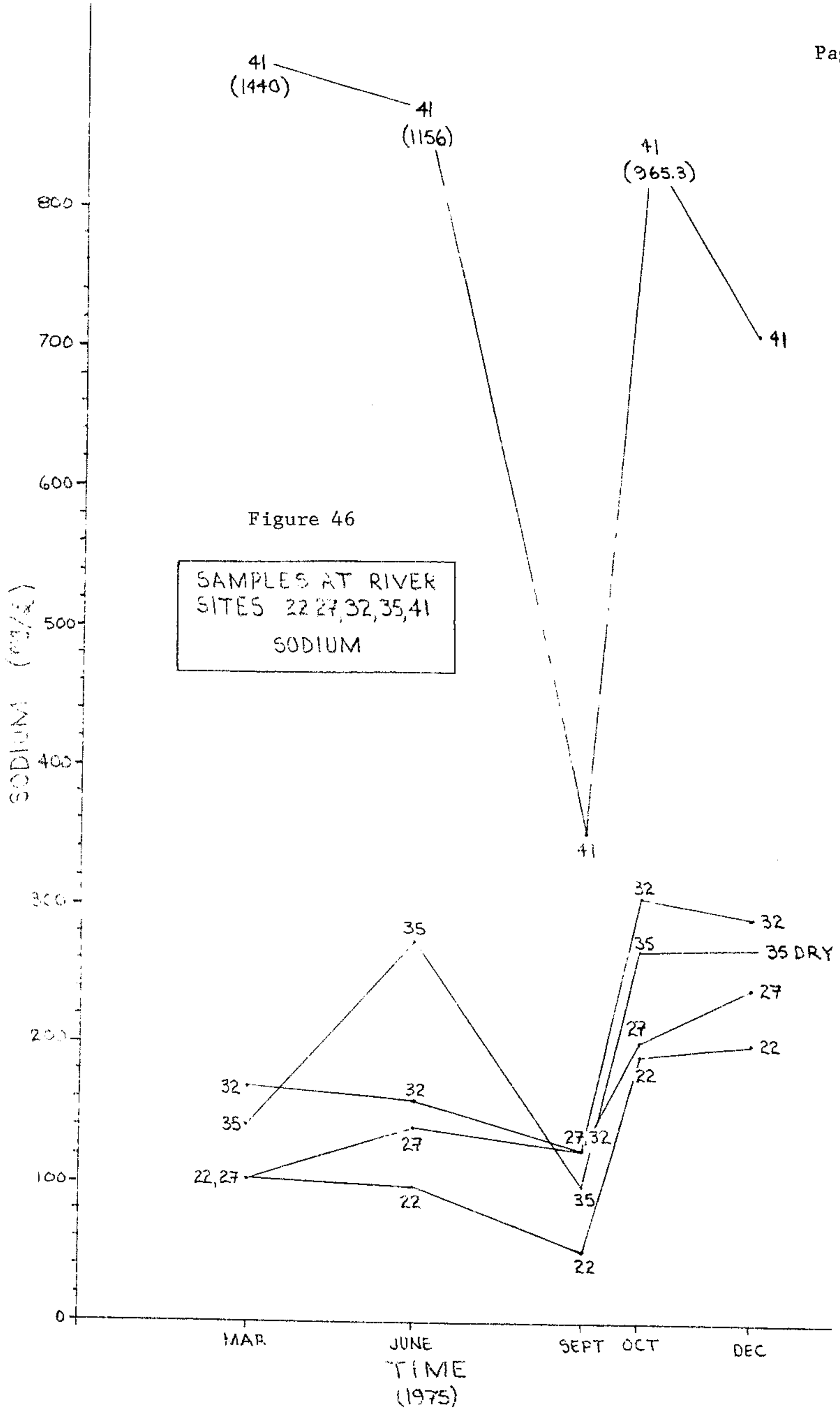

SAMPLES AT S.T.P.
SITES 5,6,11,20,25
MAGNESIUM
SAMPLES AT S.T.P.
SITES 33,38,42,43,44
MAGNESIUM
MAGNESIUM (mg/l)
0
10
20
30
40
MAR
JUNE
SEPT
OCT
DEC
TIME
(1975)

Figure 45


SAMPLES AT RIVER
SITES 1,2,3,4,7
SODIUM
SAMPLES AT RIVER
SITES 8,9,14,16,18
SODIUM
SAMPLES AT DRAIN
SITES 10,12,13,15,17
SODIUM
300
200
100
SODIUM
2 DRY
17 DRY
MAR
JUNE
SEPT
OCT
DEC
TIME
(1975)



SAMPLES AT RIVER SITES 22 27, 32, 35, 41 SODIUM
SODIUM
TIME (1975)
MAR
JUNE
SEPT
OCT
DEC
41 (1440)
41 (1156)
41 (965.3)
41
35 DRY

Figure 46

Figure 47

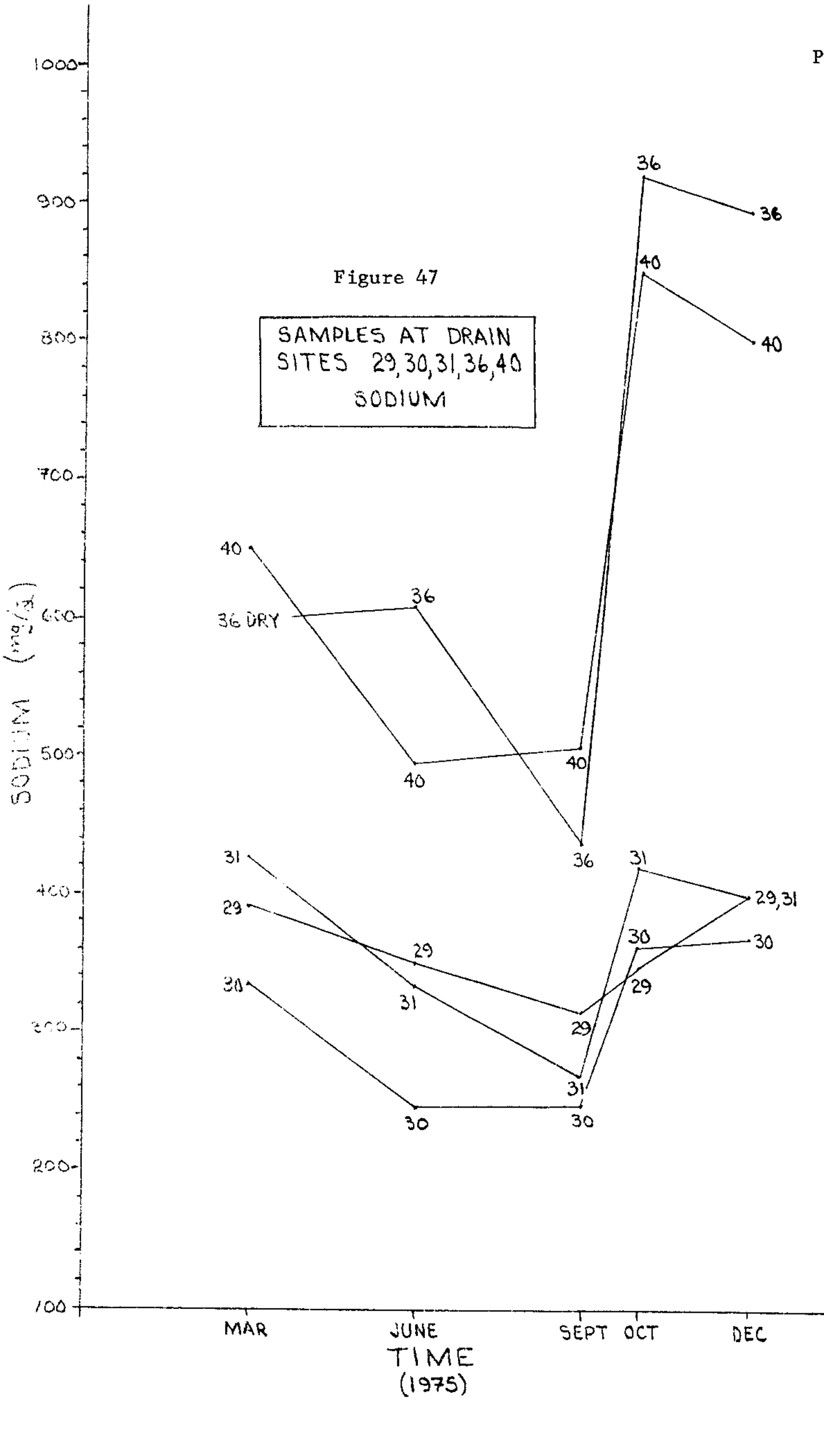
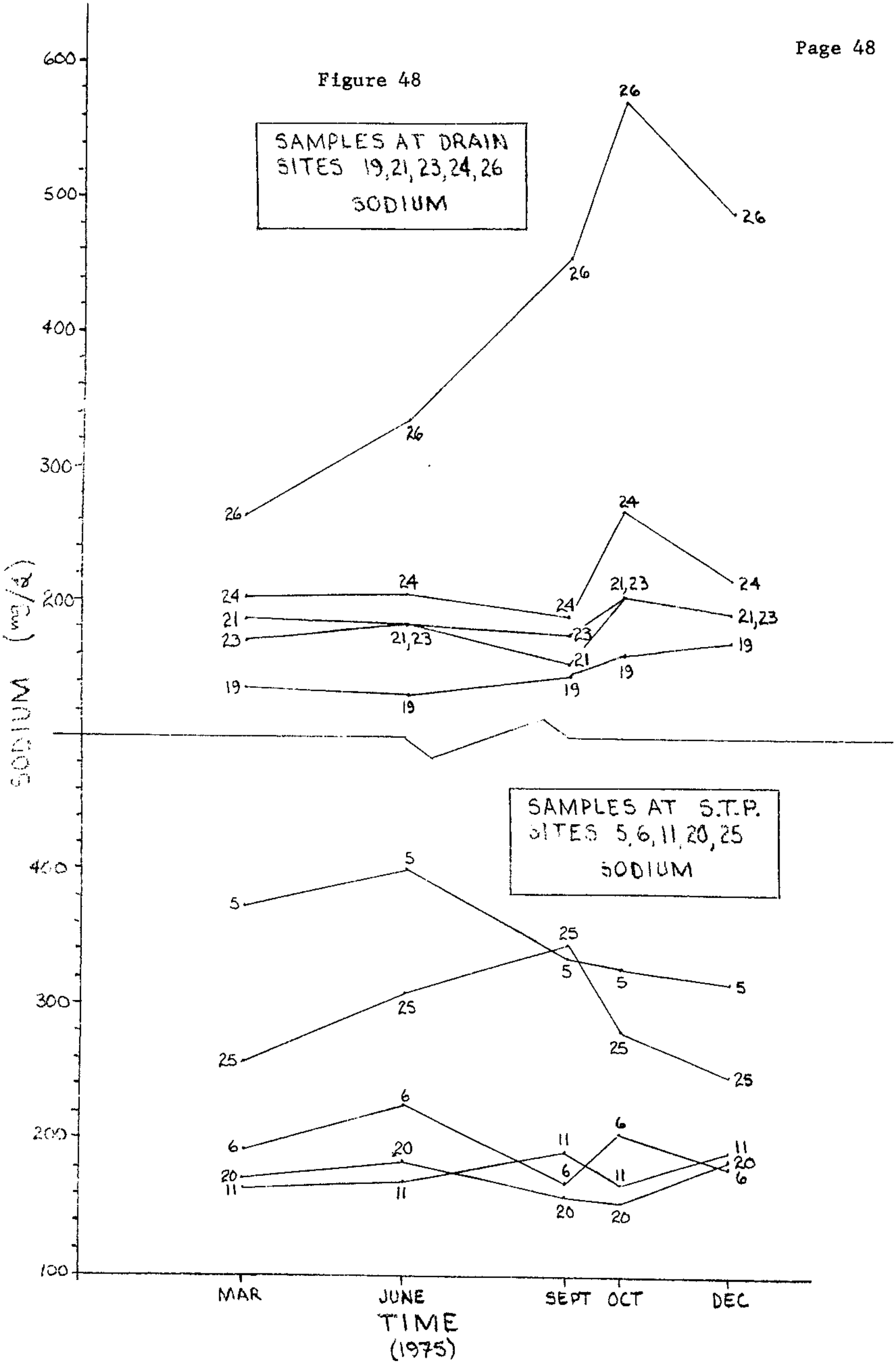
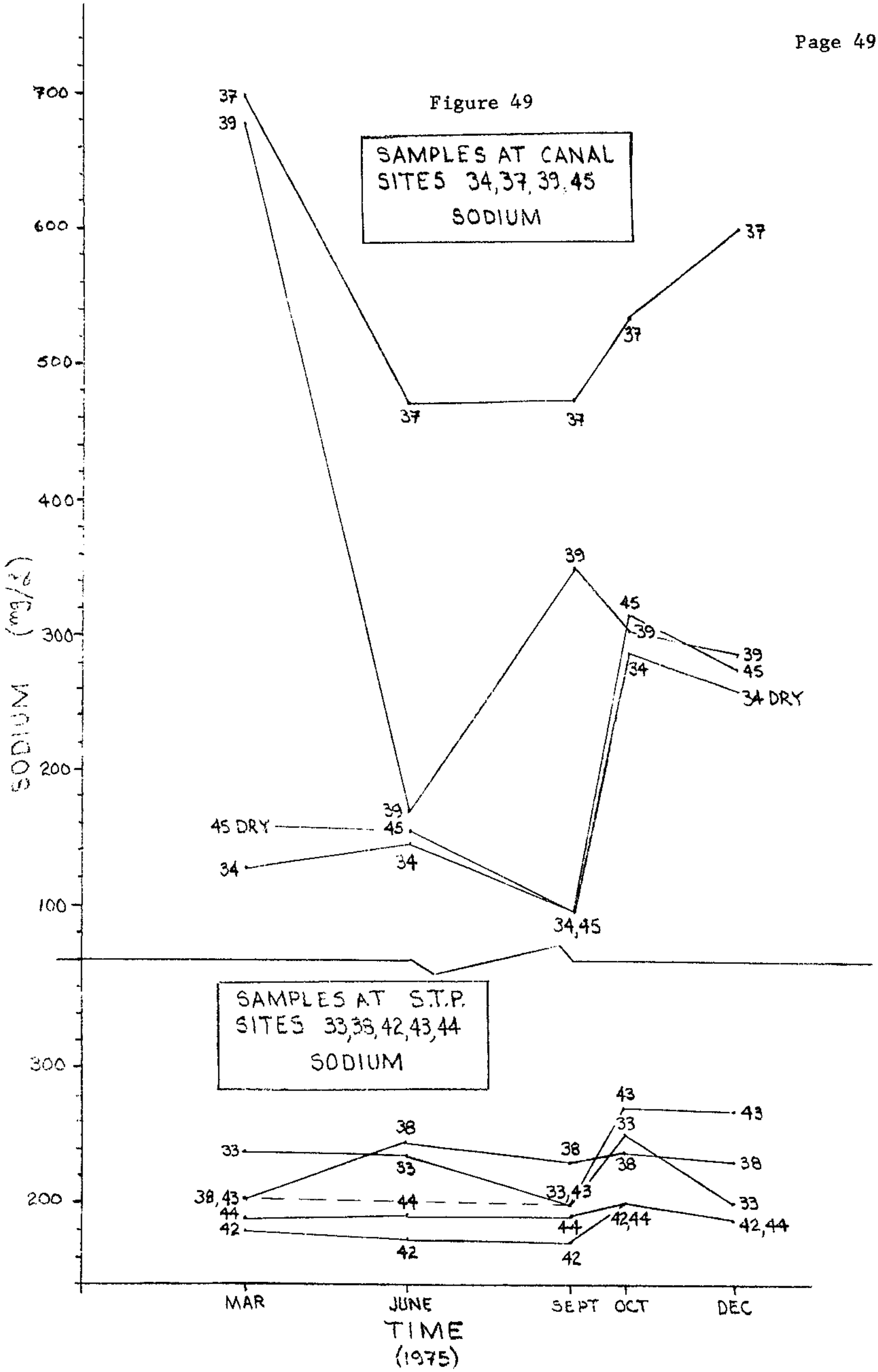

SAMPLES AT DRAIN
SITES 29,30,31,36,40
SODIUM
SODIUM (mg/l)
1000
900
800
700
600
500
400
300
200
100
36
36
40
40
40
36 DRY
36
40
40
36
31
29
30
29
31
30
29
31
30
31
30
29
29,31
30
MAR
JUNE
SEPT
OCT
DEC
TIME
(1975)

Figure 48



SAMPLES AT DRAIN SITES 19,21,23,24,26
SODIUM
SAMPLES AT S.T.P. SITES 5,6,11,20,25
SODIUM
SODIUM (mg/l)
600
500
400
300
200
400
300
200
100
MAR
JUNE
SEPT
OCT
DEC
TIME
(1975)

Figure 49


SAMPLES AT CANAL SITES 34,37,39,45 SODIUM
SAMPLES AT S.T.P. SITES 33,38,42,43,44 SODIUM
SODIUM (mg/l)
700
600
500
400
300
200
100
37
39
45 DRY
34
34,45
34 DRY
300
200
33
38,43
44
42
38
43
33,43
42,44
MAR
JUNE
SEPT
OCT
DEC
TIME
(1975)

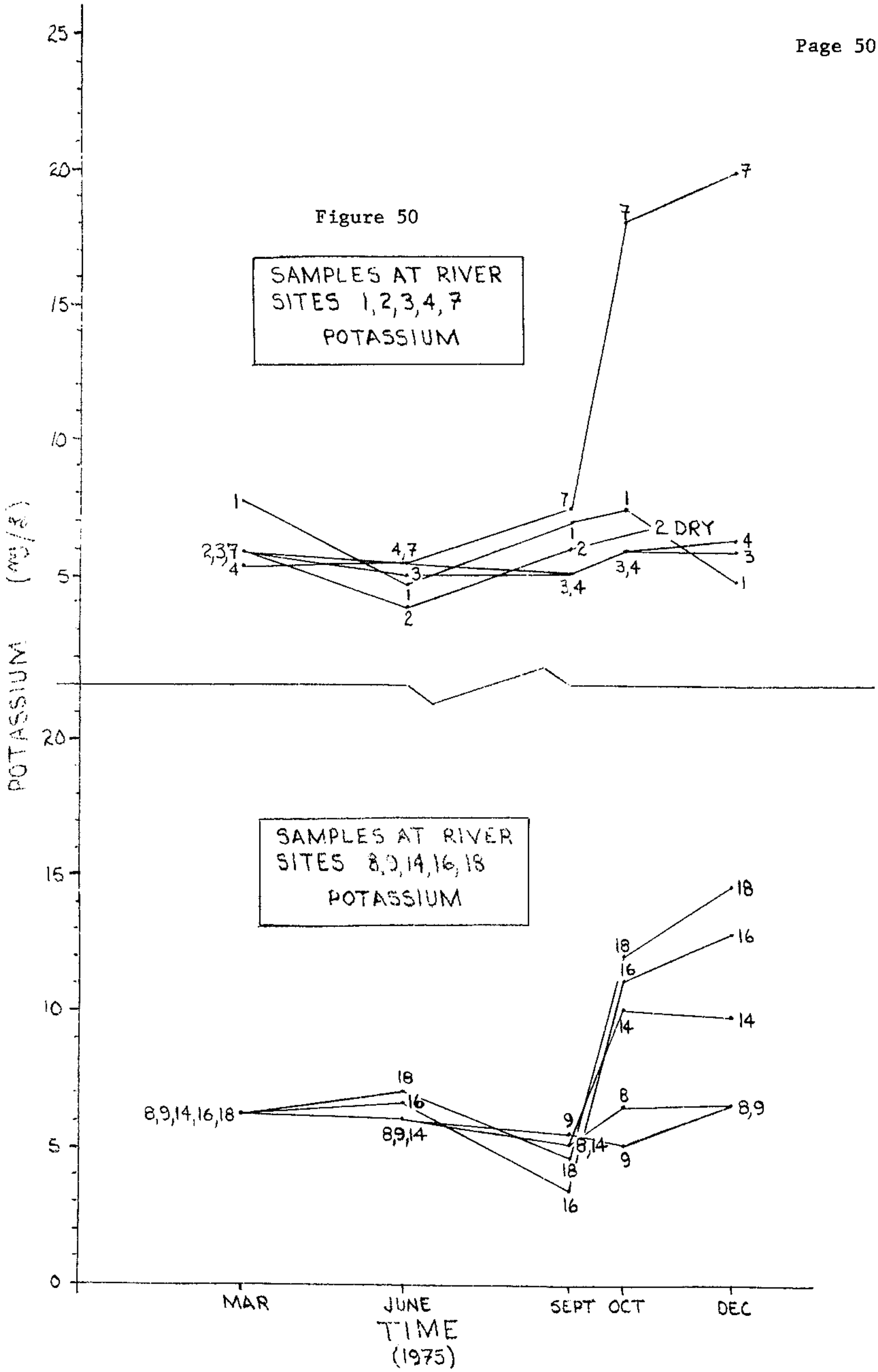
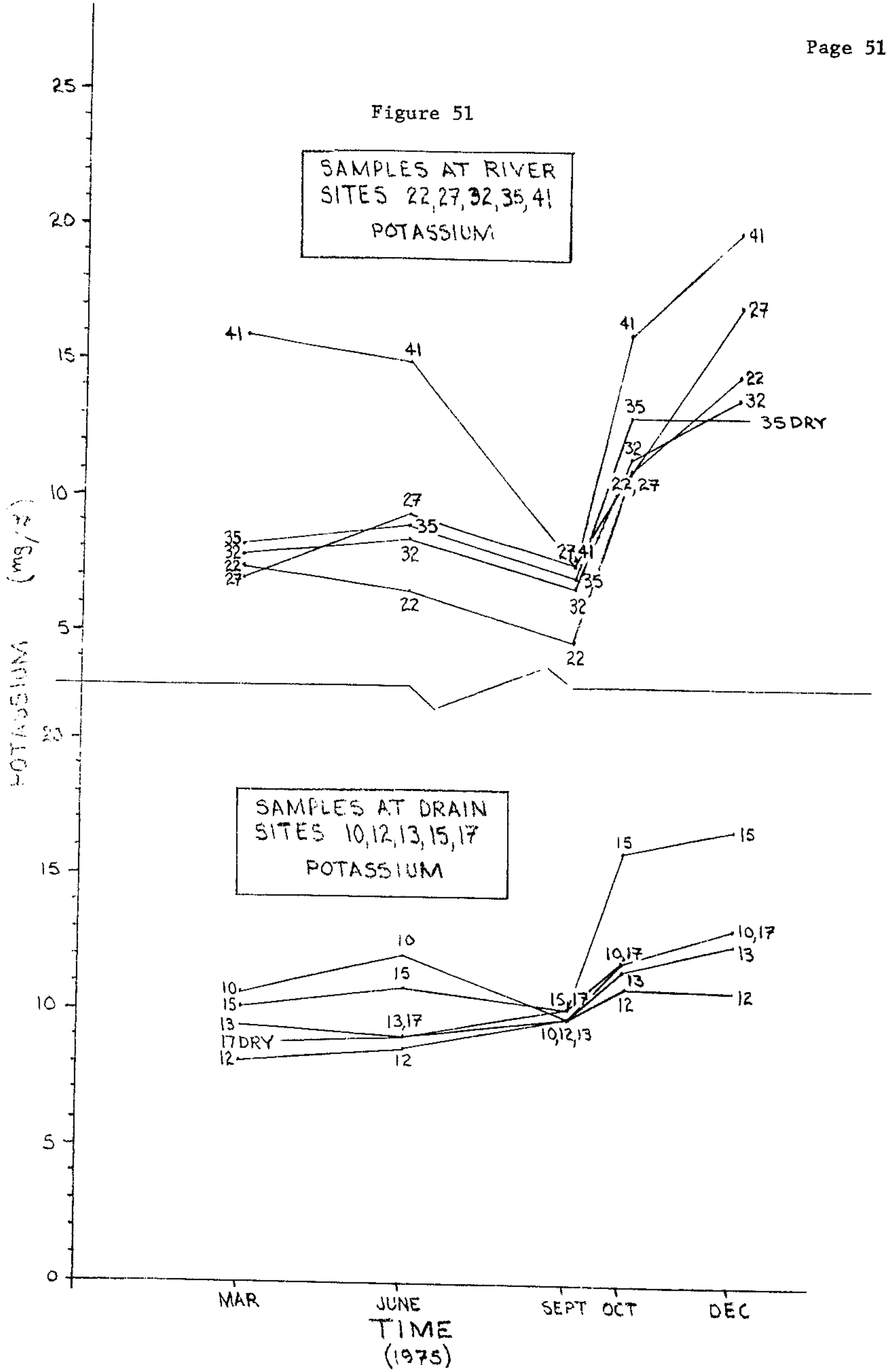
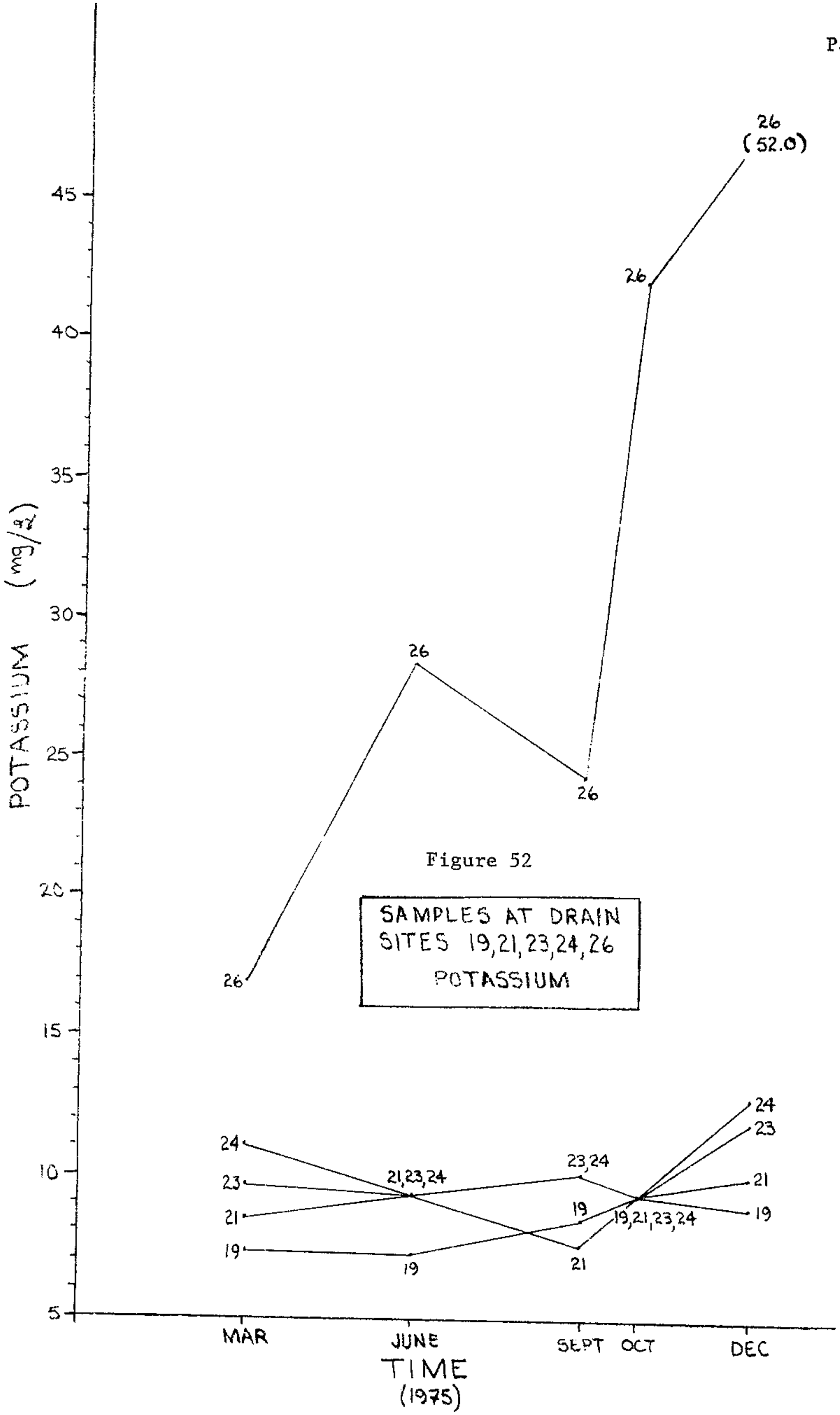

SAMPLES AT RIVER
SITES 1,2,3,4,7
POTASSIUM
SAMPLES AT RIVER
SITES 8,9,14,16,18
POTASSIUM
POTASSIUM
TIME
(1975)
MAR
JUNE
SEPT
OCT
DEC
2 DRY

Figure 50

Figure 51


SAMPLES AT RIVER SITES 22,27,32,35,41
POTASSIUM
SAMPLES AT DRAIN SITES 10,12,13,15,17
POTASSIUM
35 DRY
17 DRY
POTASSIUM (mg/l)
MAR
JUNE
SEPT
OCT
DEC
TIME
(1975)



26
(52.0)
26
26
26
26
45
40
35
30
25
20
15
10
5
POTASSIUM (mg/l)
SAMPLES AT DRAIN
SITES 19,21,23,24,26
POTASSIUM
24
23
21
19
21,23,24
19
23,24
19
21
19,21,23,24
24
23
21
19
MAR
JUNE
SEPT
OCT
DEC
TIME
(1975)

Figure 52

Figure 53

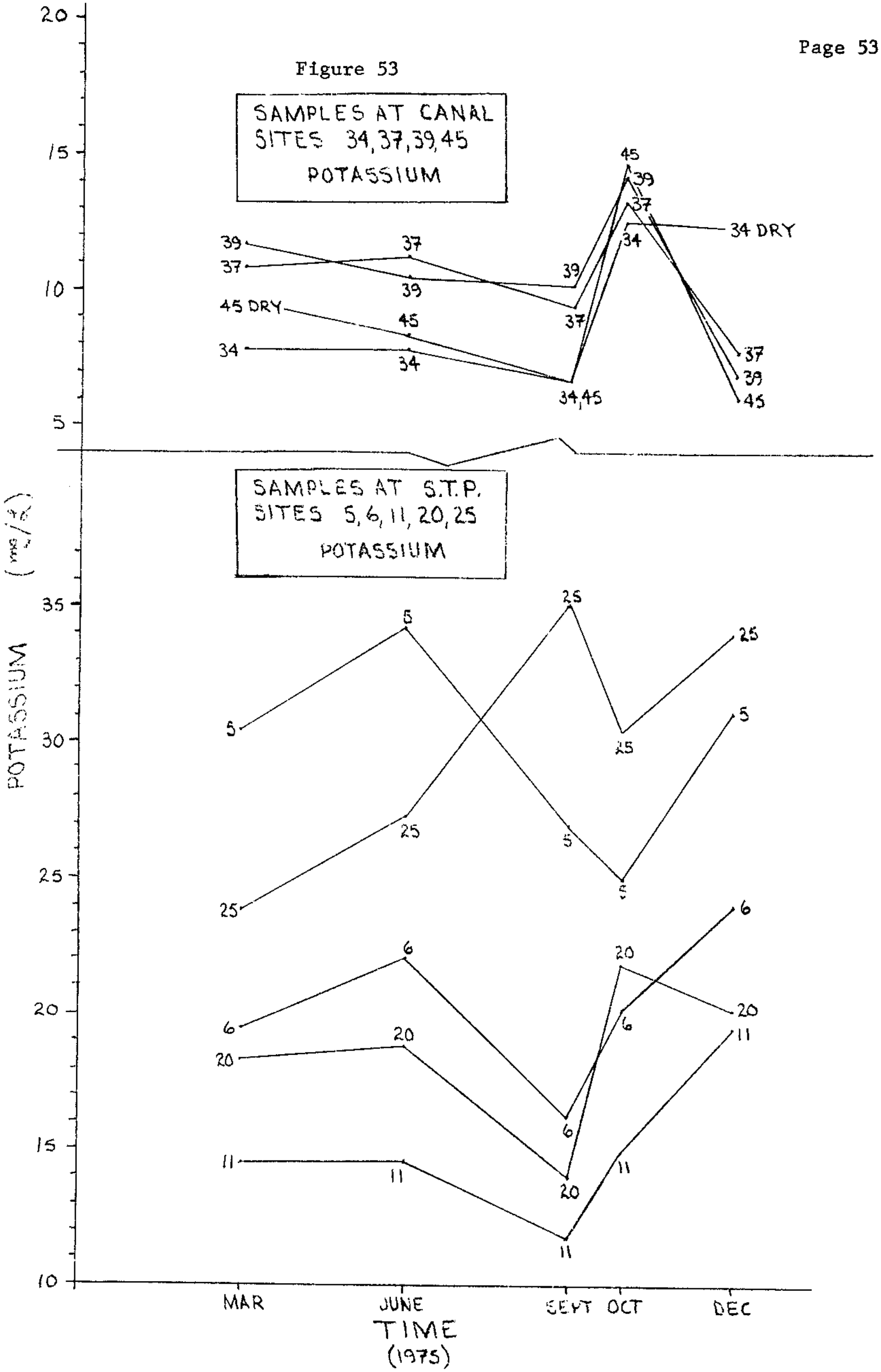

SAMPLES AT CANAL
SITES 34,37,39,45
POTASSIUM
SAMPLES AT S.T.P.
SITES 5,6,11,20,25
POTASSIUM
34 DRY
45 DRY
POTASSIUM (mg/ℓ)
TIME
(1975)
MAR
JUNE
SEPT
OCT
DEC

Figure 54

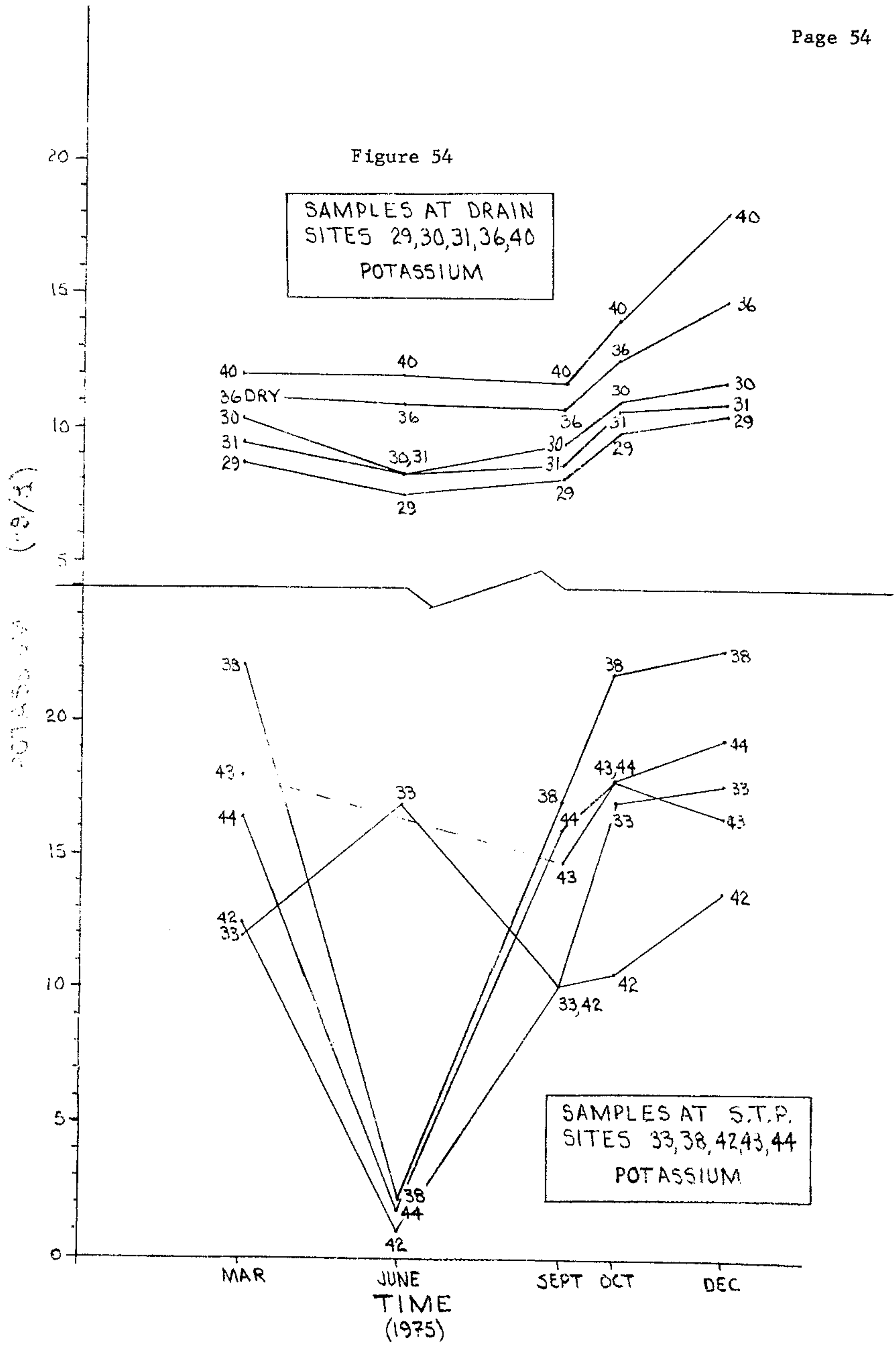

SAMPLES AT DRAIN
SITES 29,30,31,36,40
POTASSIUM
SAMPLES AT S.T.P.
SITES 33,38,42,43,44
POTASSIUM
36 DRY
MAR
JUNE
SEPT
OCT
DEC
TIME
(1975)

Figure 55

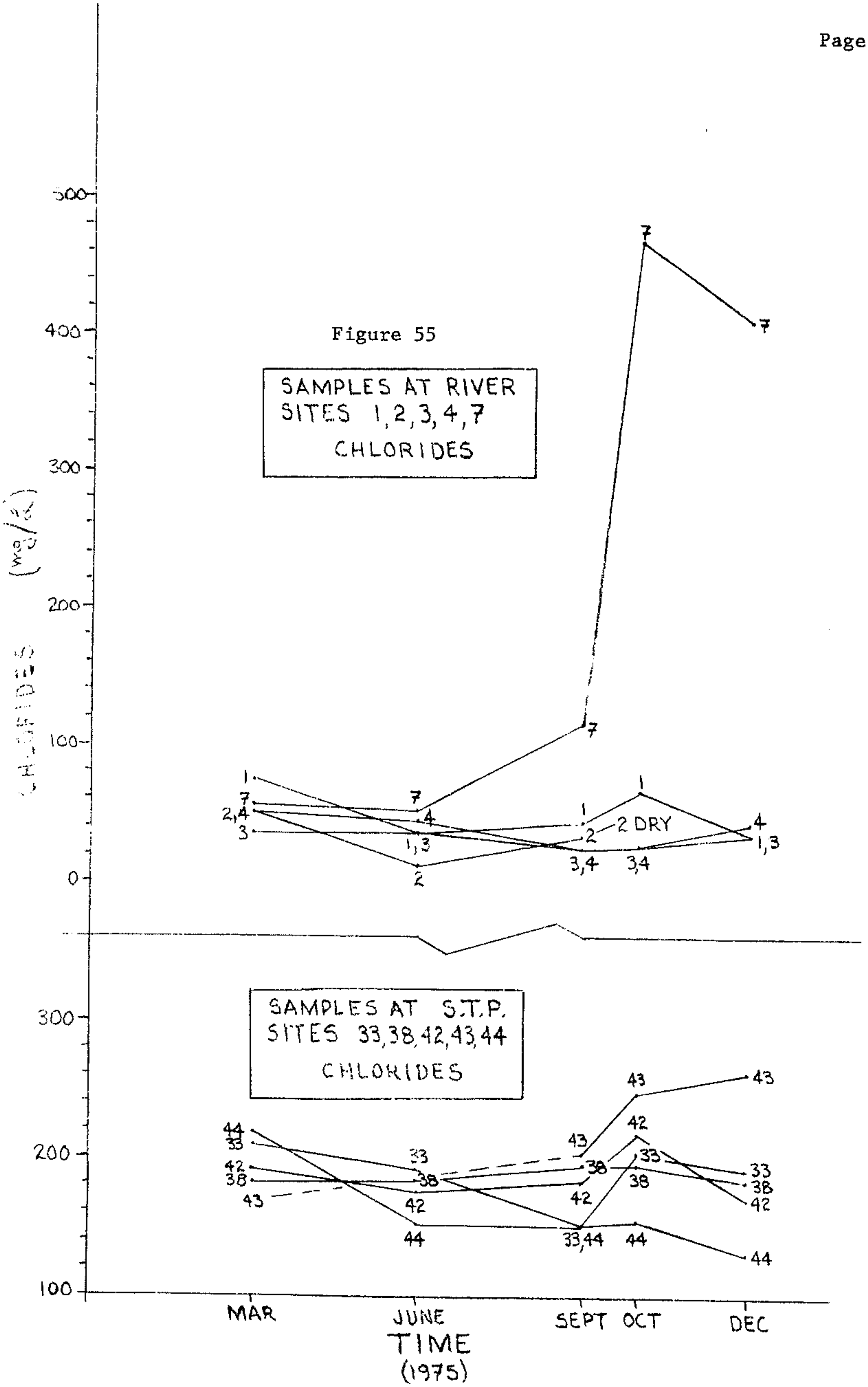

SAMPLES AT RIVER
SITES 1,2,3,4,7
CHLORIDES
SAMPLES AT S.T.P.
SITES 33,38,42,43,44
CHLORIDES
CHLORIDES (mg/l)
500
400
300
200
100
0
300
200
100
2 DRY
MAR
JUNE
SEPT
OCT
DEC
TIME
(1975)

Figure 56

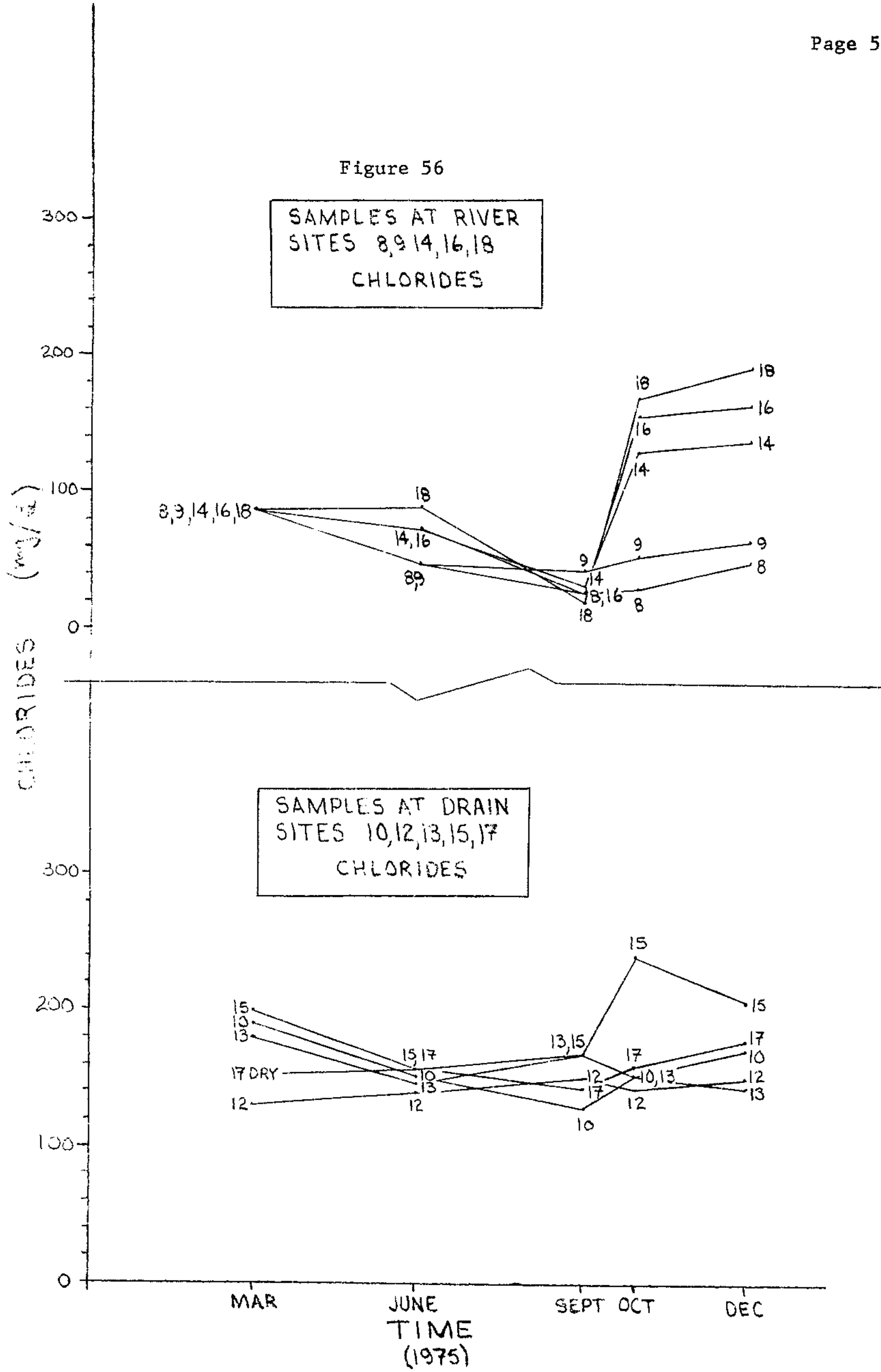
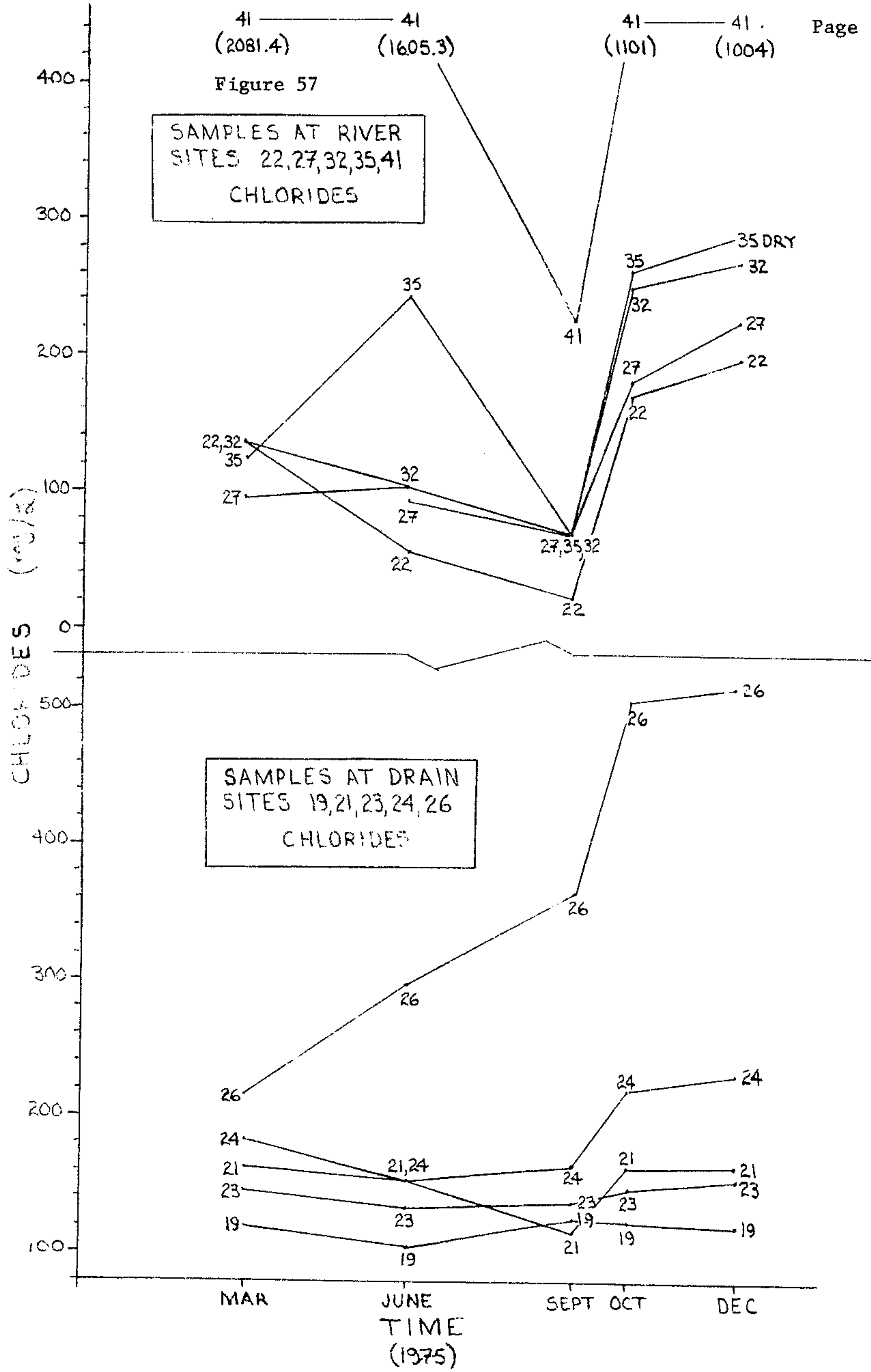
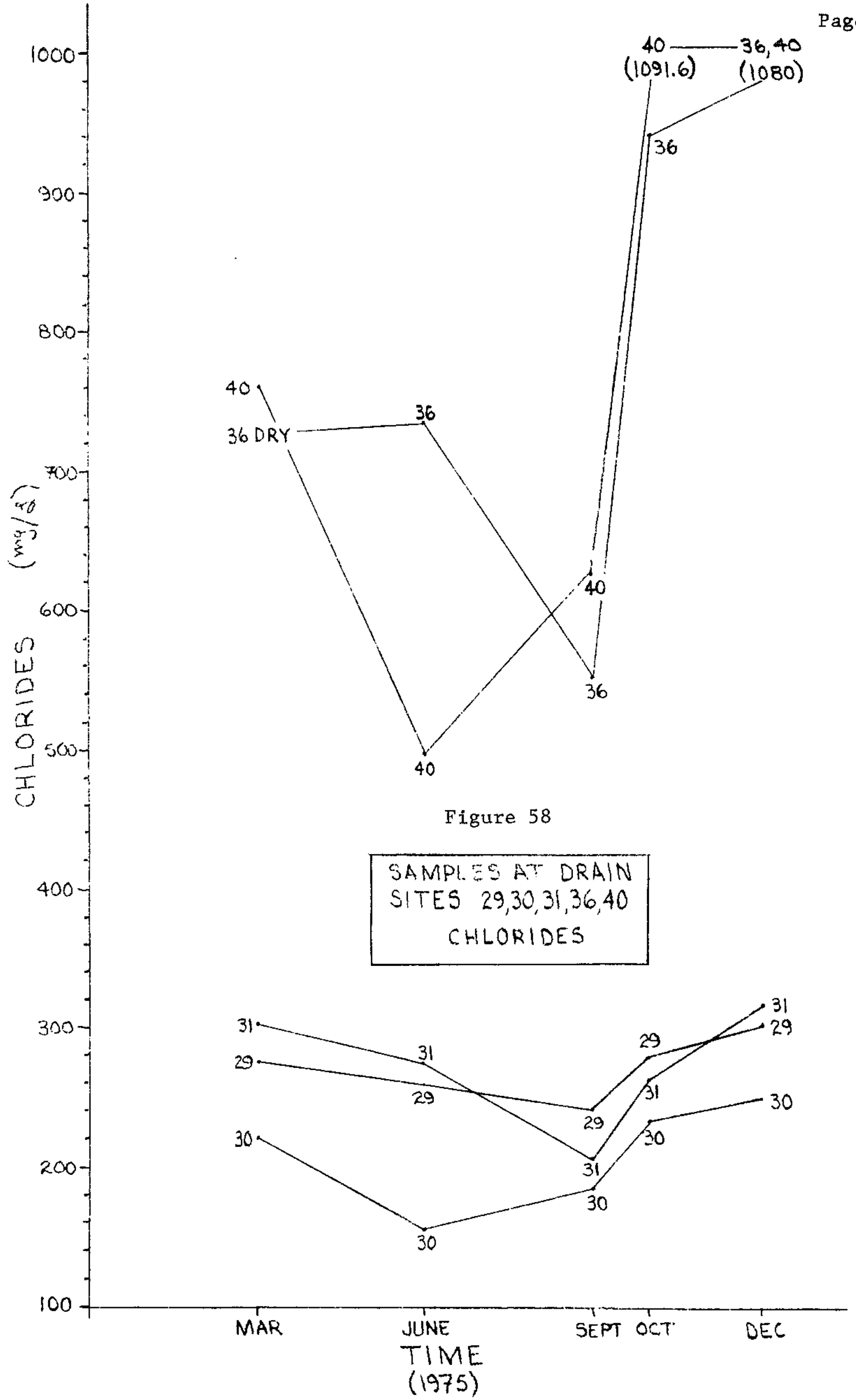

SAMPLES AT RIVER
SITES 8,9 14,16,18
CHLORIDES
SAMPLES AT DRAIN
SITES 10,12,13,15,17
CHLORIDES
CHLORIDES (mg/l)
300
200
100
0
MAR
JUNE
SEPT
OCT
DEC
TIME
(1975)
17 DRY

Figure 57


SAMPLES AT RIVER SITES 22,27,32,35,41 CHLORIDES
SAMPLES AT DRAIN SITES 19,21,23,24,26 CHLORIDES
41 (2081.4)
41 (1605.3)
41 (1101)
41 (1004)
35 DRY
CHLORIDES (mg/l)
TIME (1975)
MAR
JUNE
SEPT
OCT
DEC
400
300
200
100
0
500
400
300
200
100



SAMPLES AT DRAIN SITES 29,30,31,36,40 CHLORIDES
CHLORIDES (mg/l)
TIME (1975)
MAR
JUNE
SEPT
OCT
DEC
100
200
300
400
500
600
700
800
900
1000
40
36 DRY
36
40
36
40
40 (1091.6)
36,40 (1080)
36
31
29
30
31
29
30
29
31
30
31
29
30

Figure 58

Figure 59

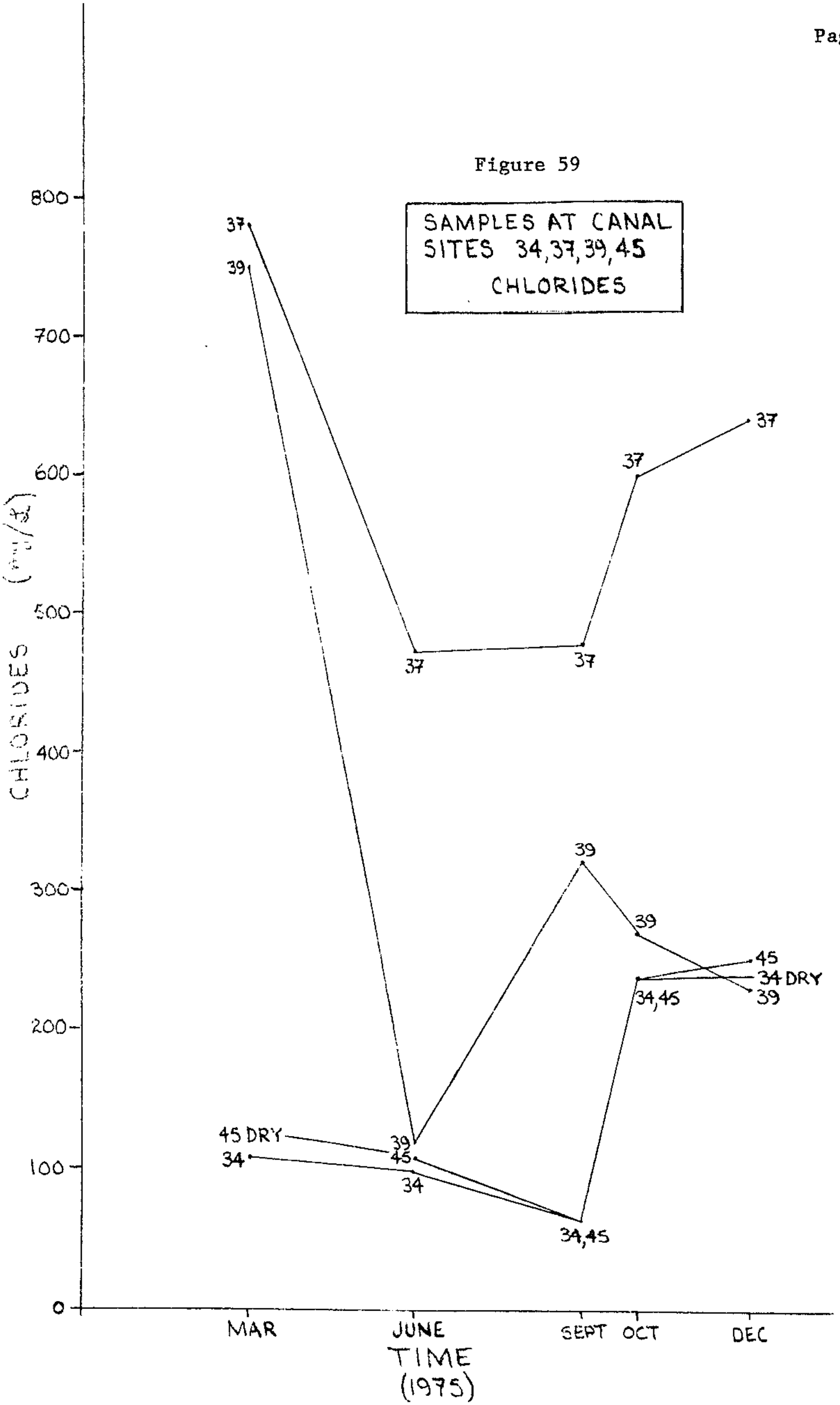
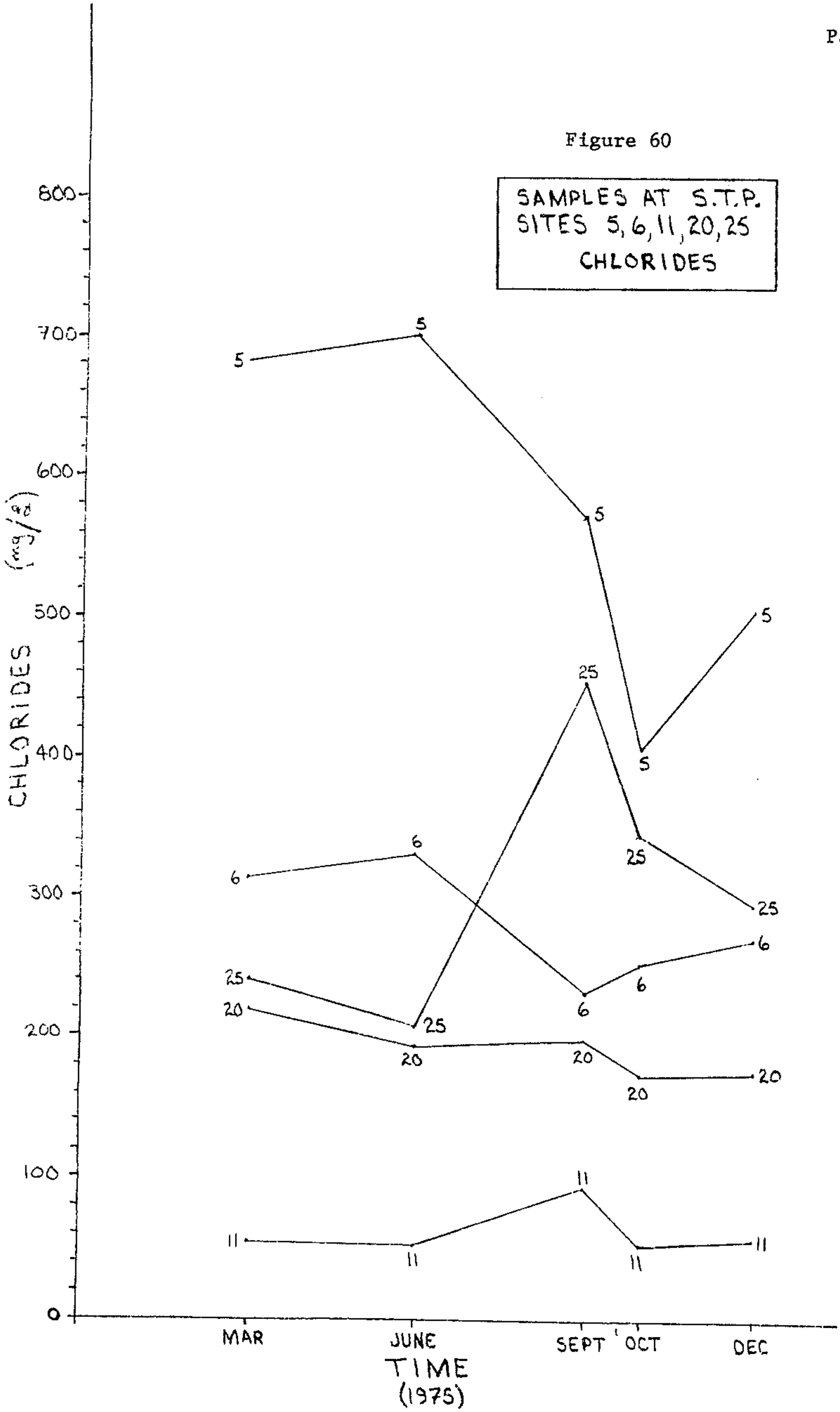

SAMPLES AT CANAL SITES 34,37,39,45
CHLORIDES
CHLORIDES (mg/l)
800
700
600
500
400
300
200
100
0
37
39
37
37
37
37
39
39
45
34 DRY
39
34,45
45 DRY
34
39
45
34
34,45
MAR
JUNE
SEPT
OCT
DEC
TIME
(1975)

Figure 60


SAMPLES AT S.T.P.
SITES 5, 6, 11, 20, 25
CHLORIDES
CHLORIDES (mg/l)
800
700
600
500
400
300
200
100
0
MAR
JUNE
SEPT
OCT
DEC
TIME
(1975)
5
6
11
20
25

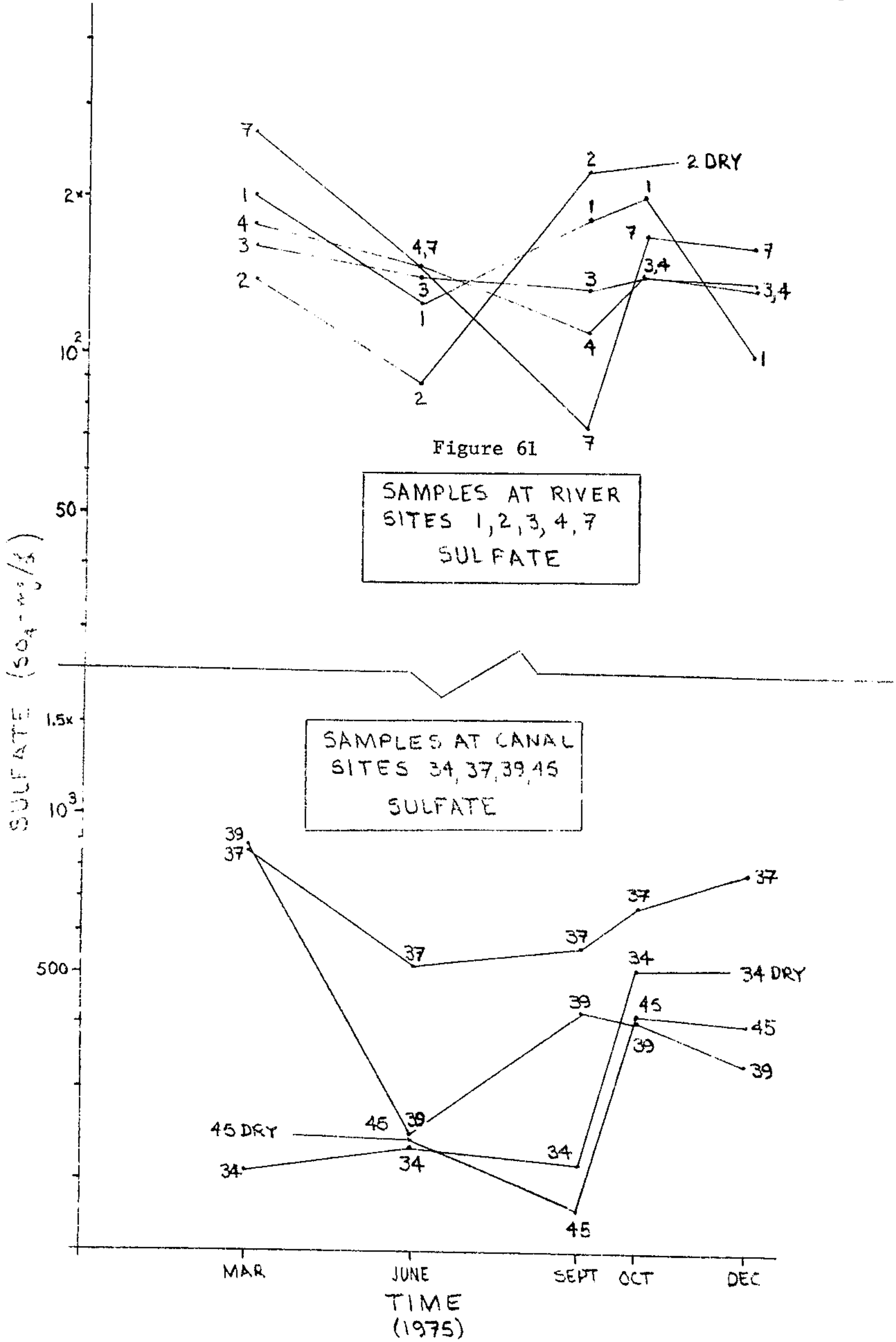
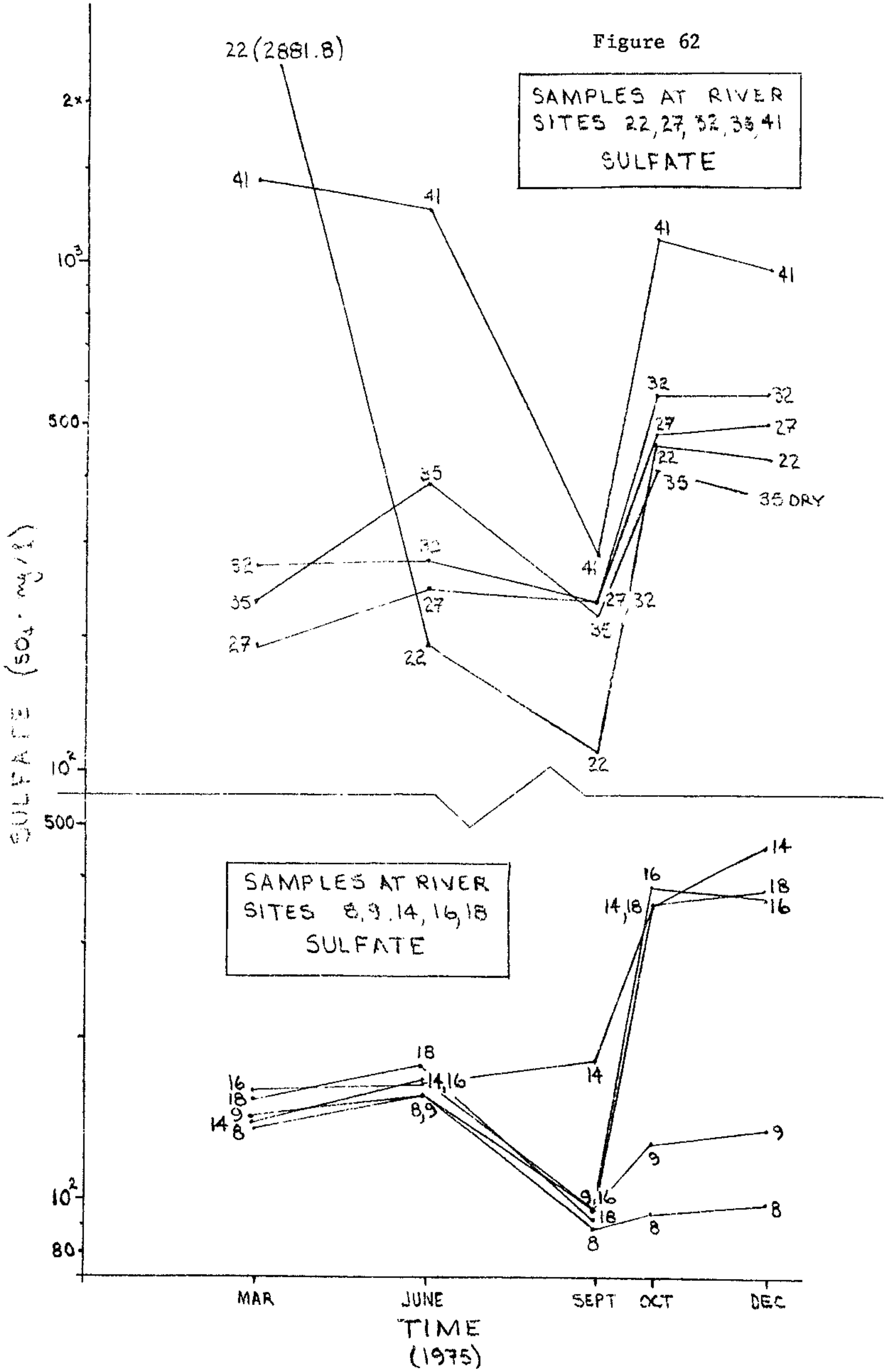

SAMPLES AT RIVER
SITES 1,2,3,4,7
SULFATE
SAMPLES AT CANAL
SITES 34,37,39,45
SULFATE
2 DRY
34 DRY
45 DRY
50
500
1.5x
2x
MAR
JUNE
SEPT
OCT
DEC
TIME
(1975)

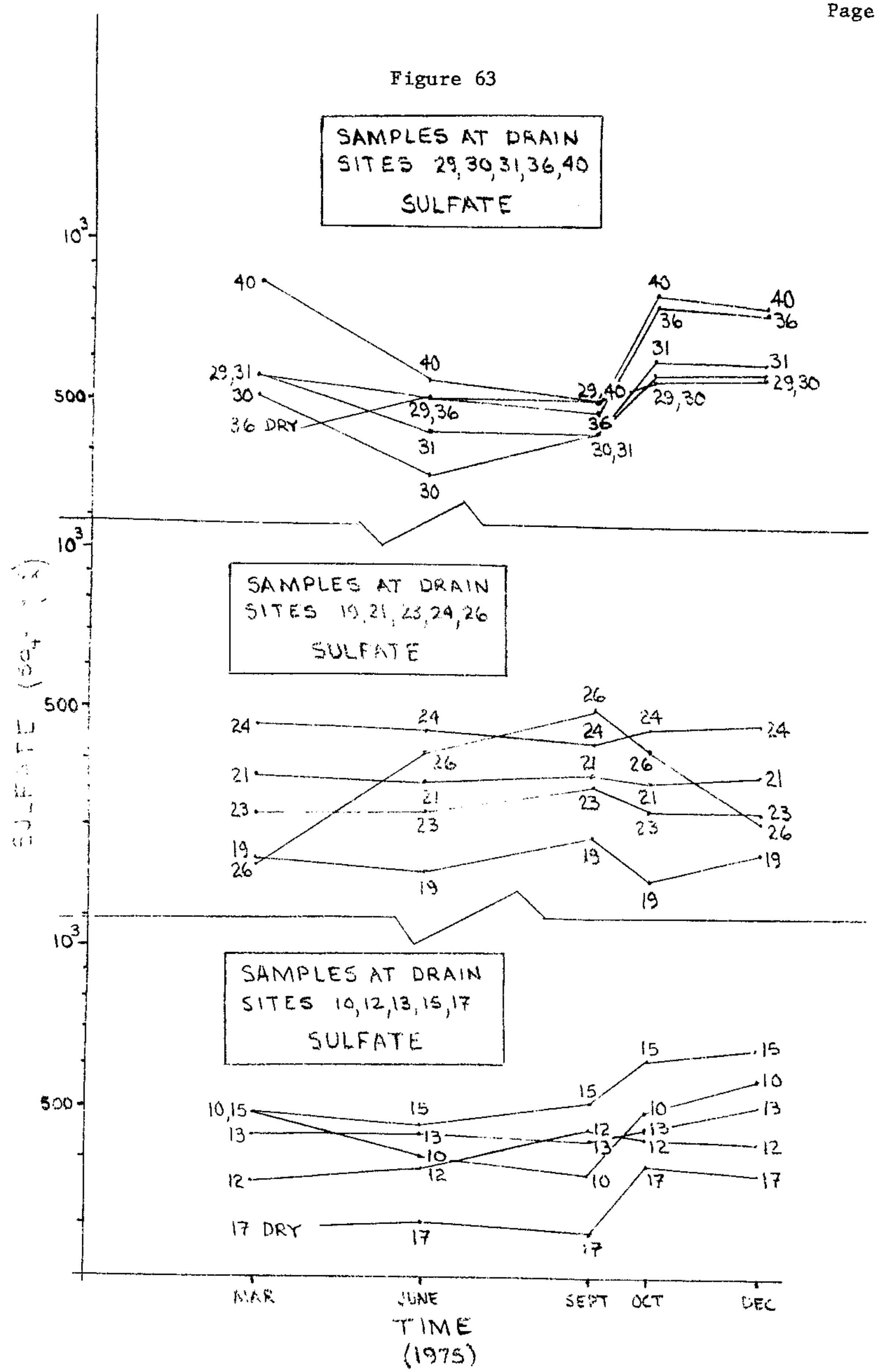
Figure 61

Figure 62



SAMPLES AT RIVER SITES 22, 27, 32, 35, 41
SULFATE
SAMPLES AT RIVER SITES 8, 9, 14, 16, 18
SULFATE
22 (2881.8)
35 DRY
SULFATE (SO4 · mg/l)
MAR
JUNE
SEPT
OCT
DEC
TIME
(1975)

Figure 63


SAMPLES AT DRAIN SITES 29,30,31,36,40 SULFATE
SAMPLES AT DRAIN SITES 19,21,23,24,26 SULFATE
SAMPLES AT DRAIN SITES 10,12,13,15,17 SULFATE
10^3
500
36 DRY
17 DRY
MAR
JUNE
SEPT
OCT
DEC
TIME
(1975)

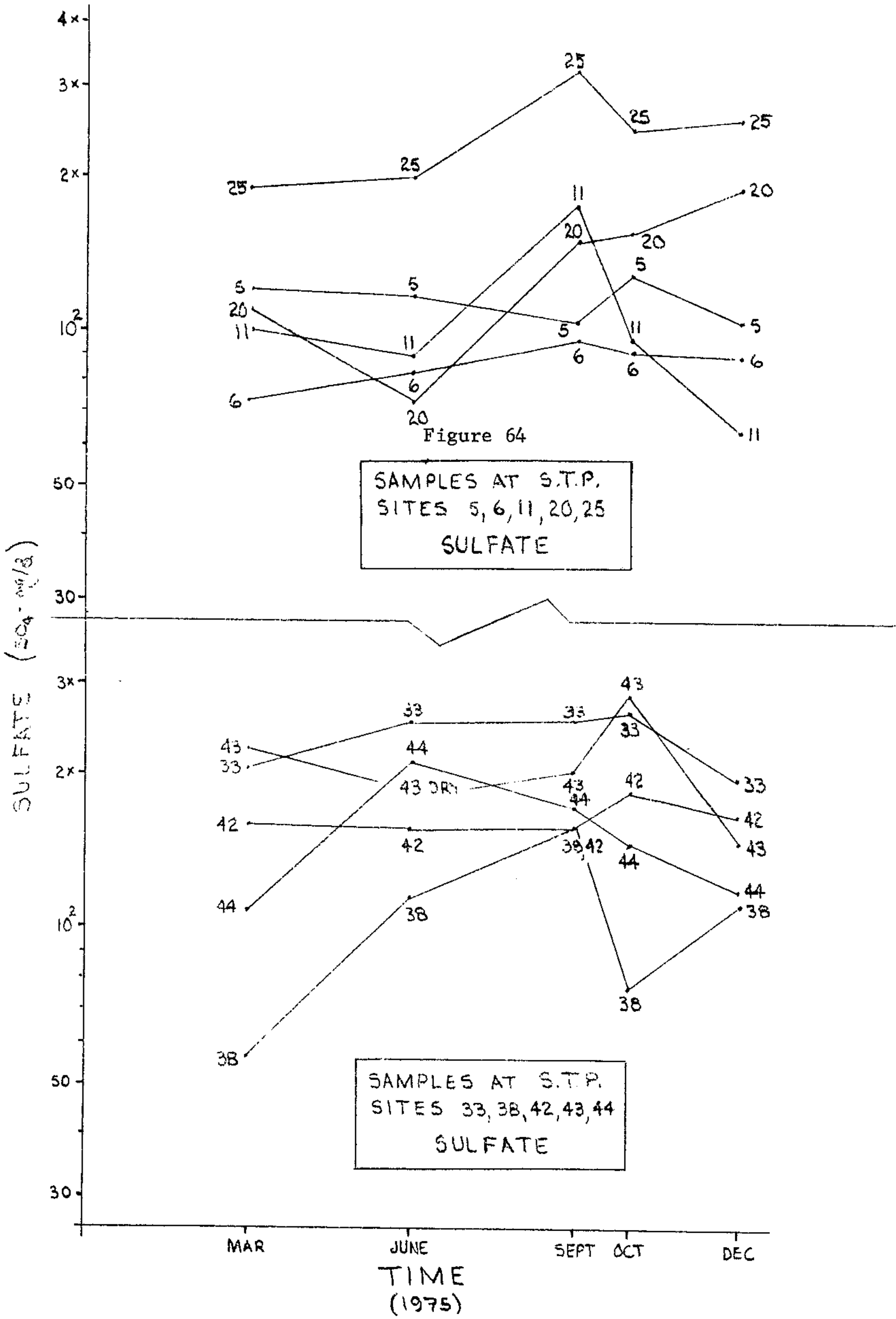

SAMPLES AT S.T.P.
SITES 5, 6, 11, 20, 25
SULFATE
SAMPLES AT S.T.P.
SITES 33, 38, 42, 43, 44
SULFATE
SULFATE
TIME
(1975)
MAR
JUNE
SEPT
OCT
DEC
43 DRY

Figure 64

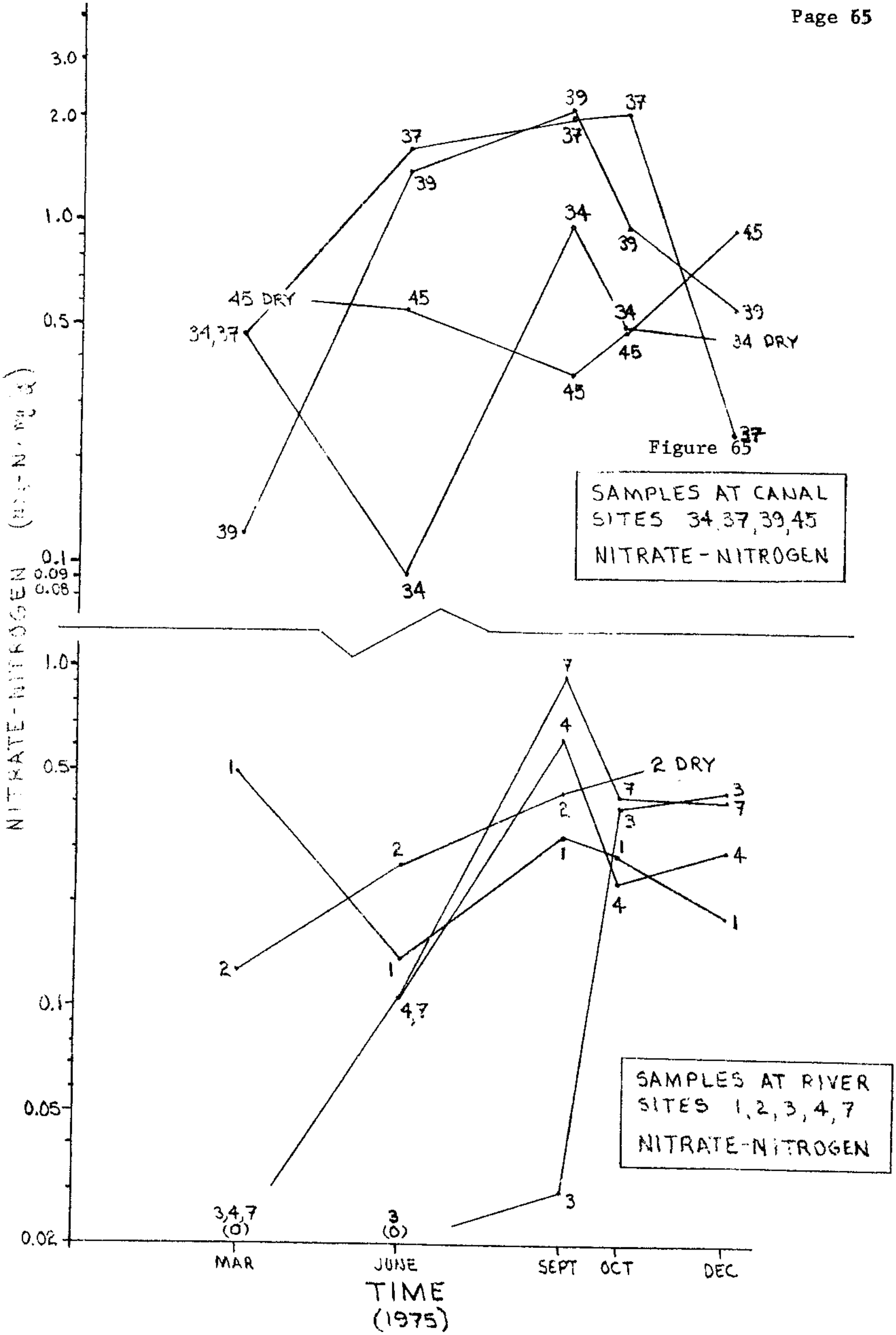
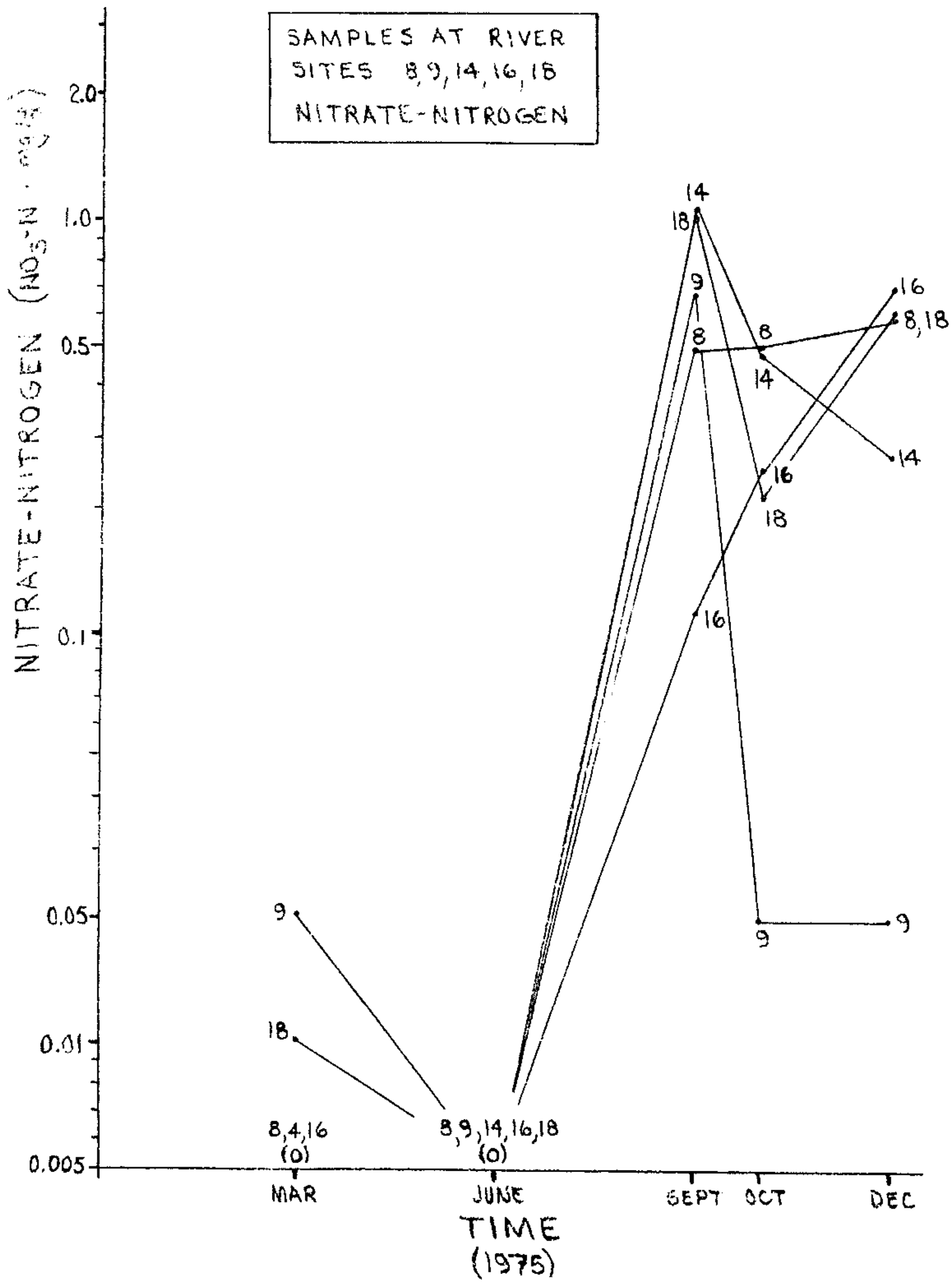
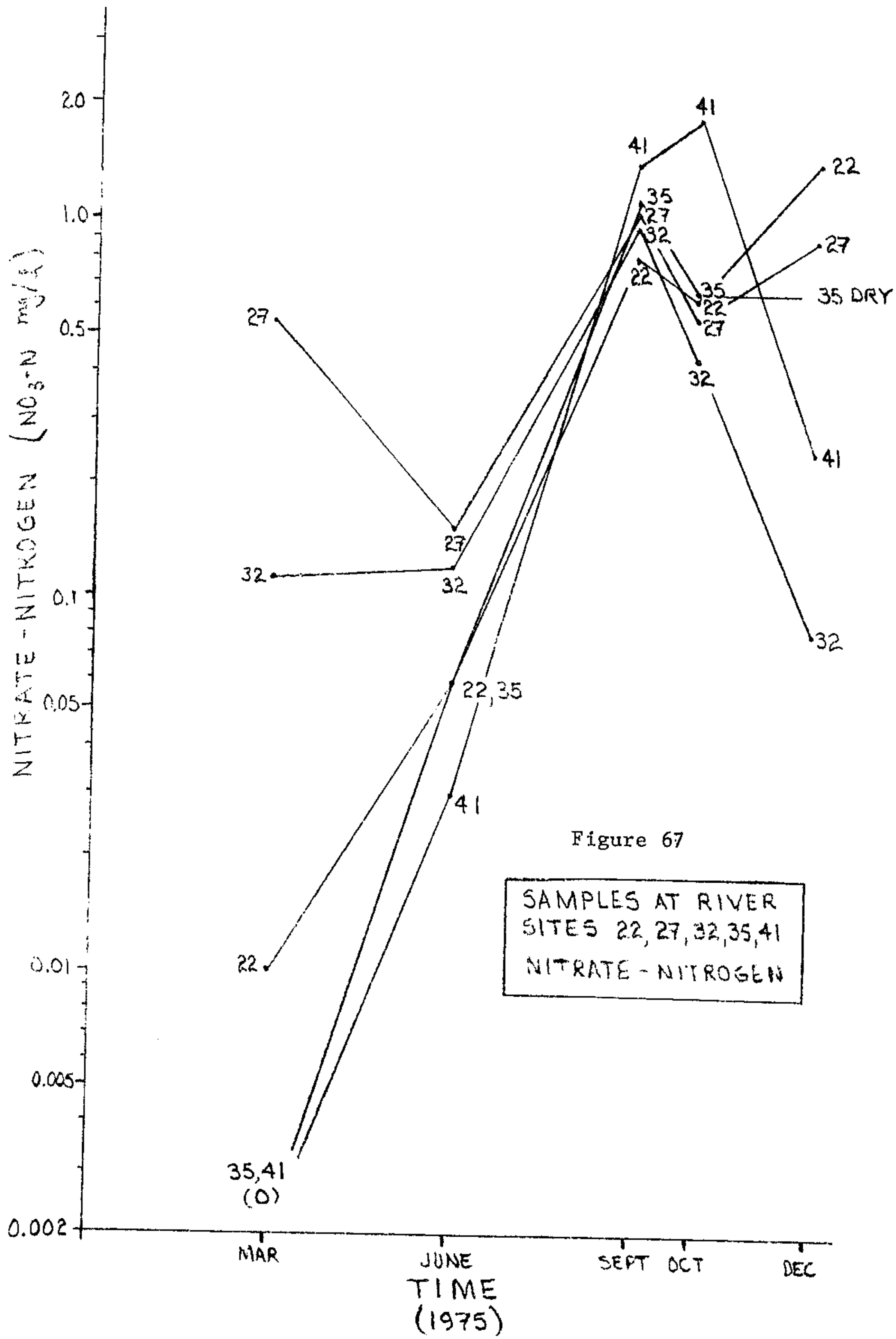

SAMPLES AT CANAL SITES 34,37,39,45
NITRATE-NITROGEN
SAMPLES AT RIVER SITES 1,2,3,4,7
NITRATE-NITROGEN
NITRATE-NITROGEN
3.0
2.0
1.0
0.5
0.1
0.09
0.08
0.05
0.02
45 DRY
34 DRY
2 DRY
MAR
JUNE
SEPT
OCT
DEC
TIME
(1975)

Figure 65

Figure 66


SAMPLES AT RIVER
SITES 8,9,14,16,18
NITRATE-NITROGEN
NITRATE-NITROGEN (NO3-N ·
2.0
1.0
0.5
0.1
0.05
0.01
0.005
14
18
9
8
16
8,18
14
16
18
9
9
18
8,4,16
(0)
8,9,14,16,18
(0)
MAR
JUNE
SEPT
OCT
DEC
TIME
(1975)



NITRATE - NITROGEN (NO3-N mg/l)
2.0
1.0
0.5
0.1
0.05
0.01
0.005
0.002
41
41
22
35
27
32
22
27
35
22
27
35 DRY
32
41
27
32
32
32
22,35
41
22
35,41
(0)
MAR
JUNE
SEPT
OCT
DEC
TIME
(1975)
SAMPLES AT RIVER
SITES 22, 27, 32, 35, 41
NITRATE - NITROGEN

Figure 67

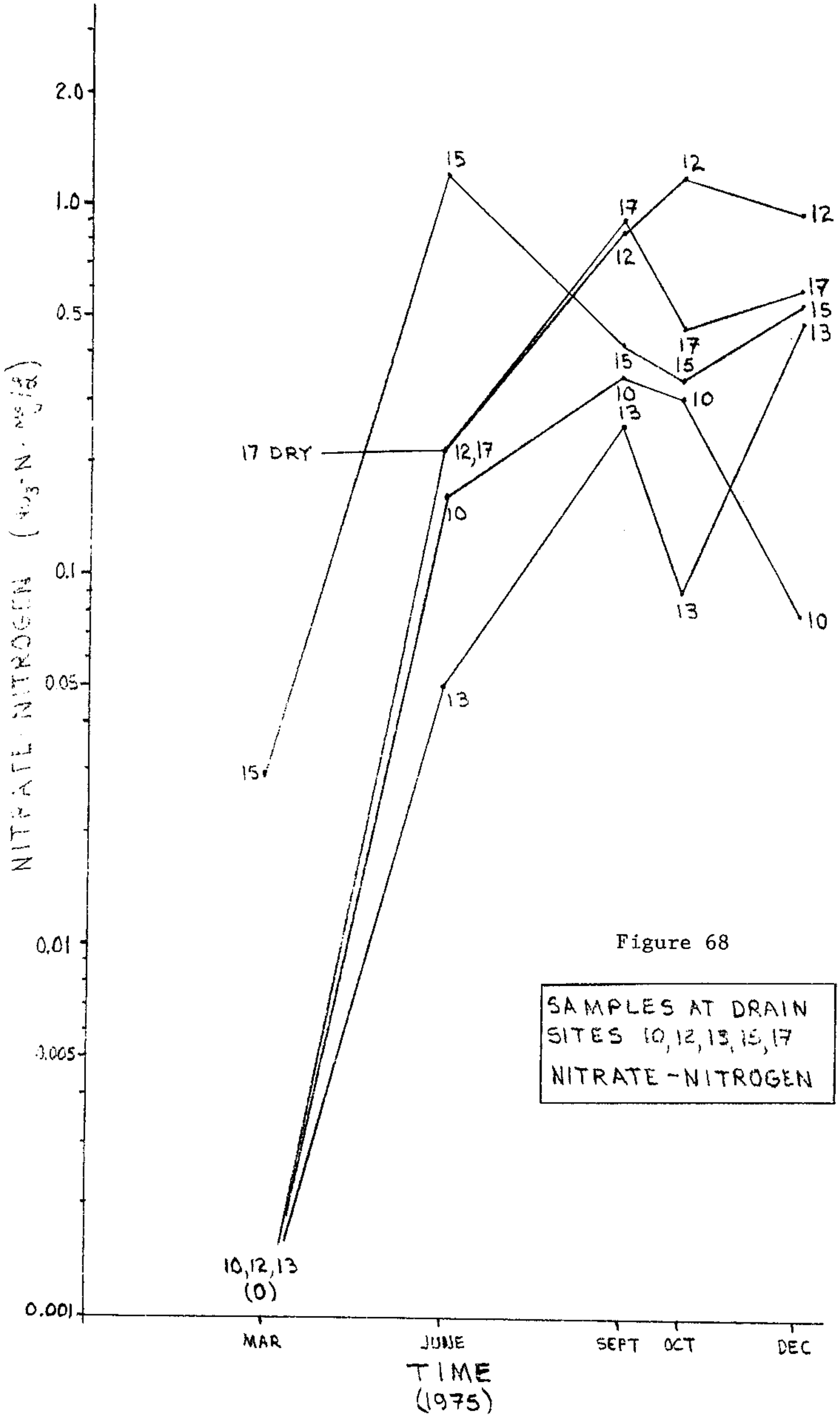

2.0
1.0
0.5
0.1
0.05
0.01
0.005
0.001
NITRATE NITROGEN
TIME
(1975)
MAR
JUNE
SEPT
OCT
DEC
17 DRY
12,17
10,12,13
(0)
SAMPLES AT DRAIN
SITES 10, 12, 13, 15, 17
NITRATE-NITROGEN

Figure 68

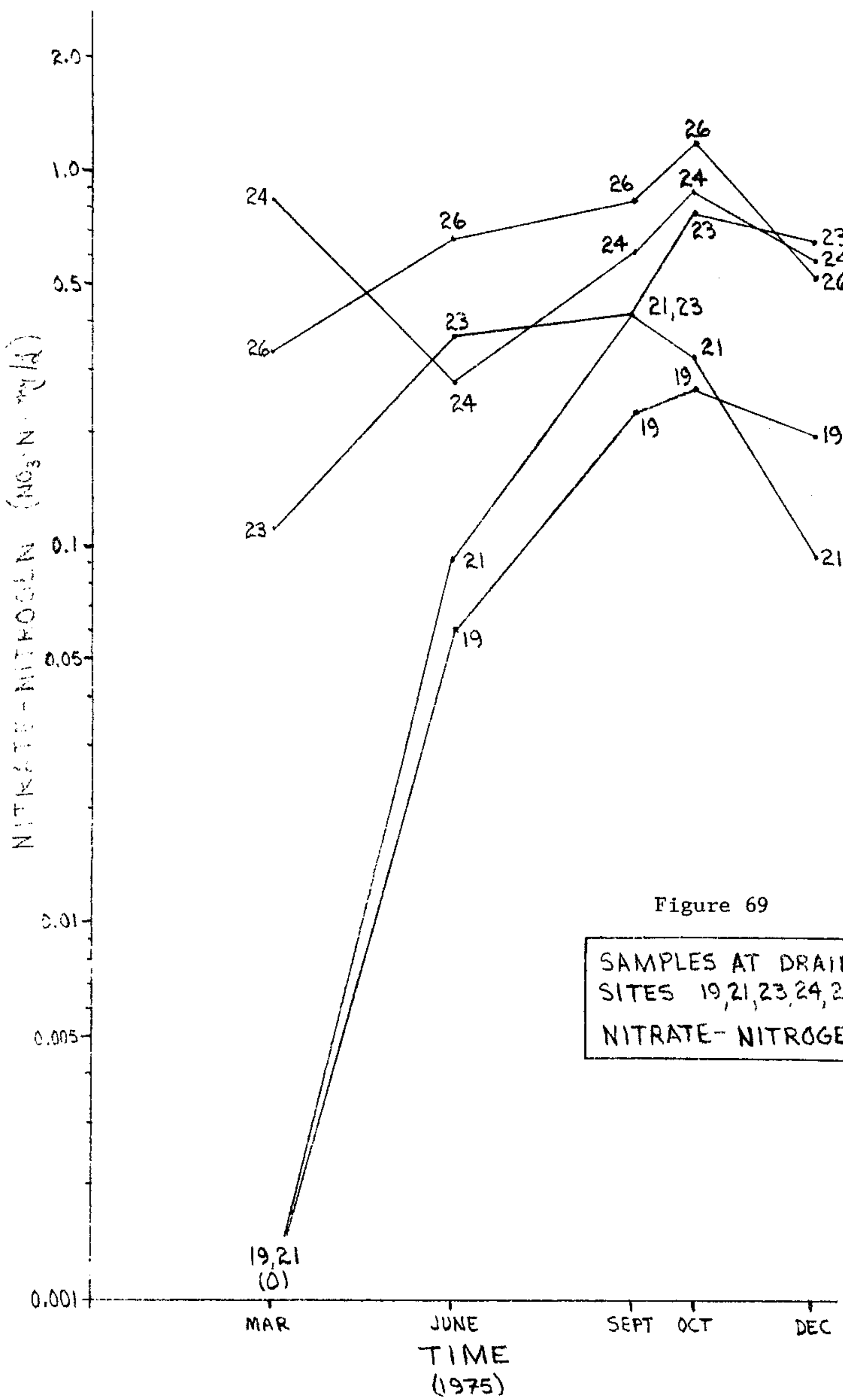


Figure 69

SAMPLES AT DRAIN SITES 19,21,23,24,26 NITRATE-NITROGEN

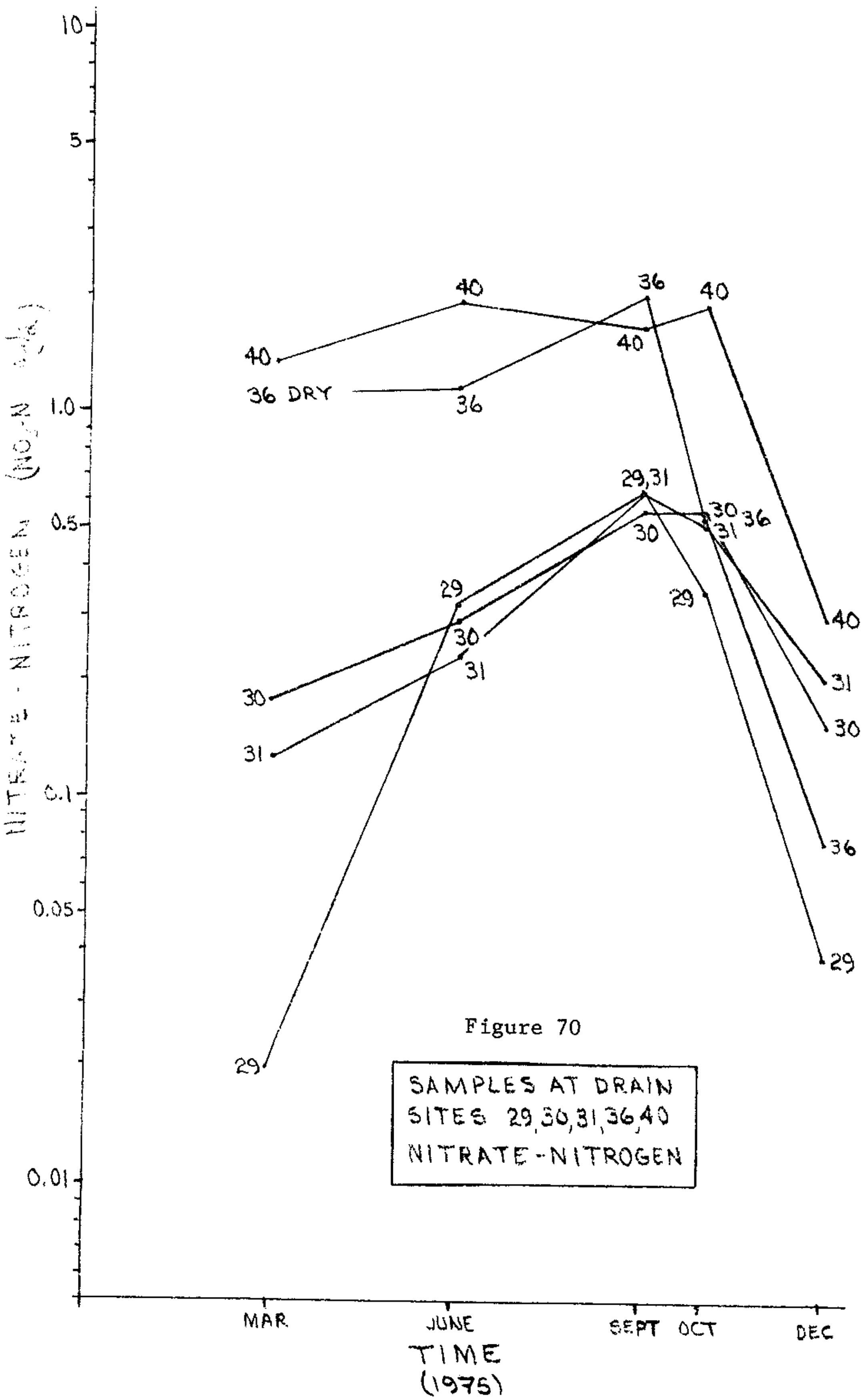

10
5
1.0
0.5
0.1
0.05
0.01
NITRATE - NITROGEN (NO_3-N mg/l)
40
36 DRY
36
29,31
30
31
29
40
30
31
36
29
MAR
JUNE
SEPT
OCT
DEC
TIME
(1975)
SAMPLES AT DRAIN
SITES 29,30,31,36,40
NITRATE-NITROGEN

Figure 70

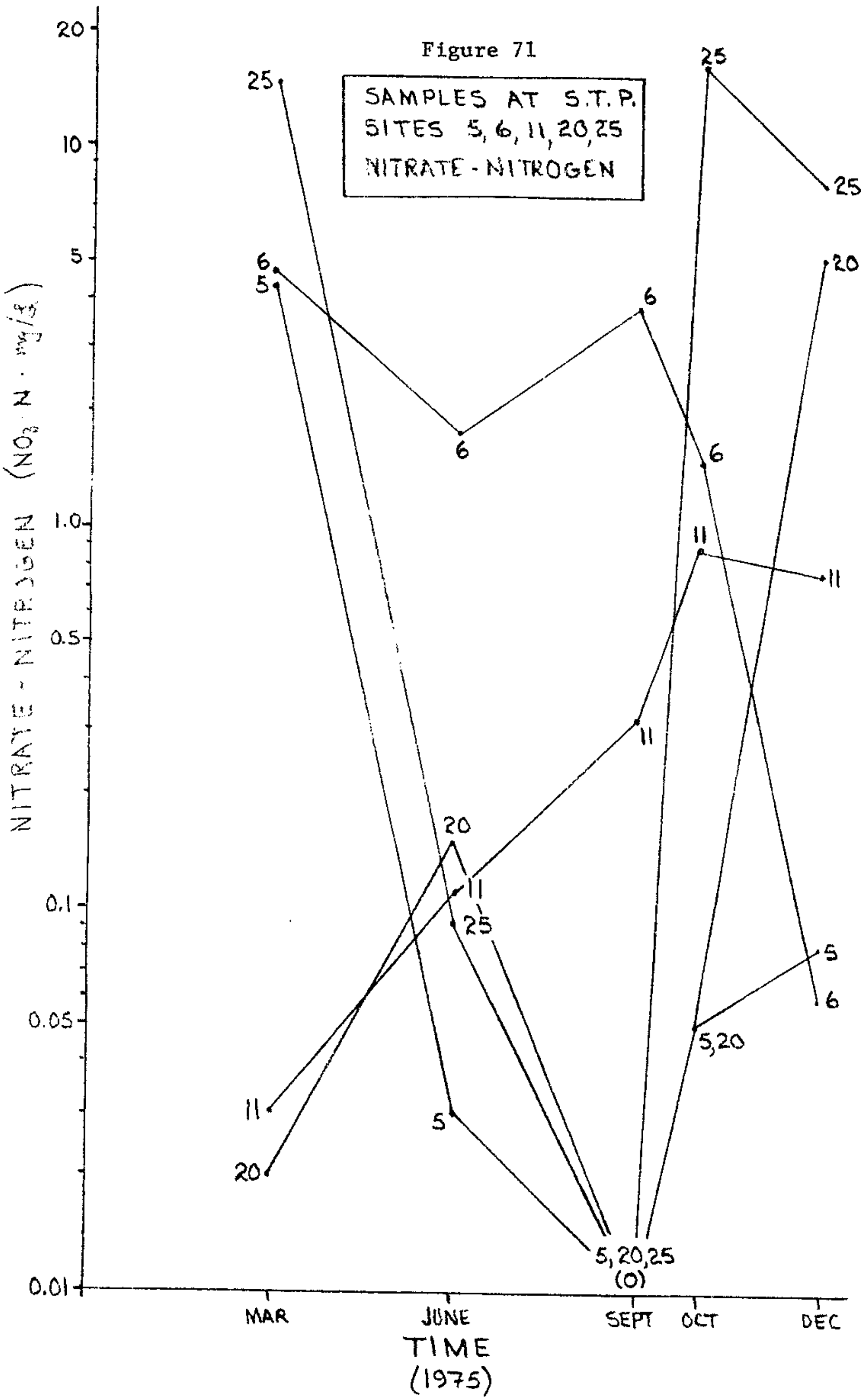


Figure 71
SAMPLES AT S.T.P.
SITES 5, 6, 11, 20, 25
NITRATE - NITROGEN
NITRATE - NITROGEN (NO3 N · mg/l)
20
10
5
1.0
0.5
0.1
0.05
0.01
25
6
5
11
20
5,20,25
(0)
5,20
MAR
JUNE
SEPT
OCT
DEC
TIME
(1975)

Figure 72

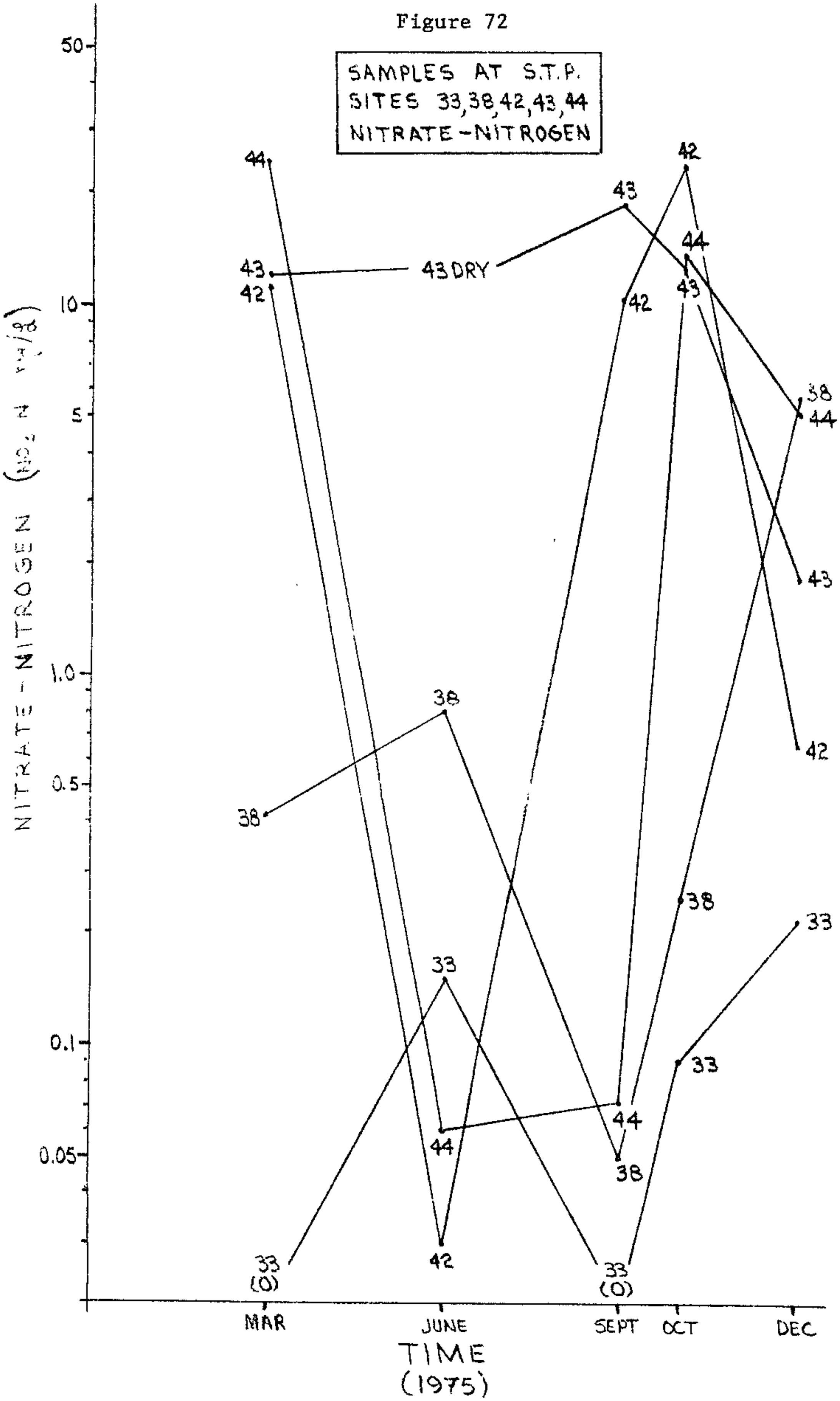

SAMPLES AT S.T.P.
SITES 33,38,42,43,44
NITRATE-NITROGEN
NITRATE-NITROGEN (NO_3 N mg/l)
50
10
5
1.0
0.5
0.1
0.05
44
43
42
38
43 DRY
33
(0)
MAR
JUNE
SEPT
OCT
DEC
TIME
(1975)

Figure 73

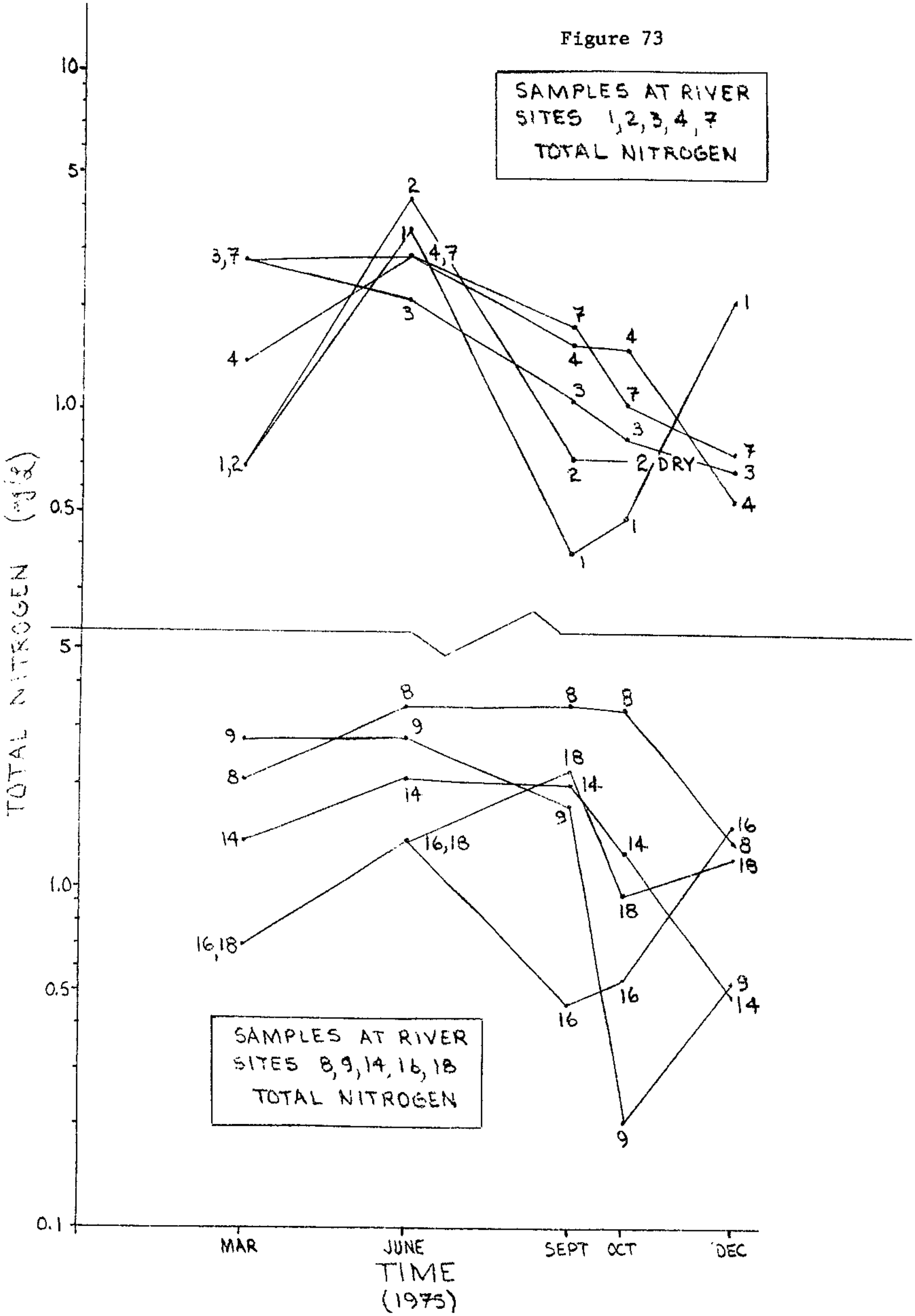
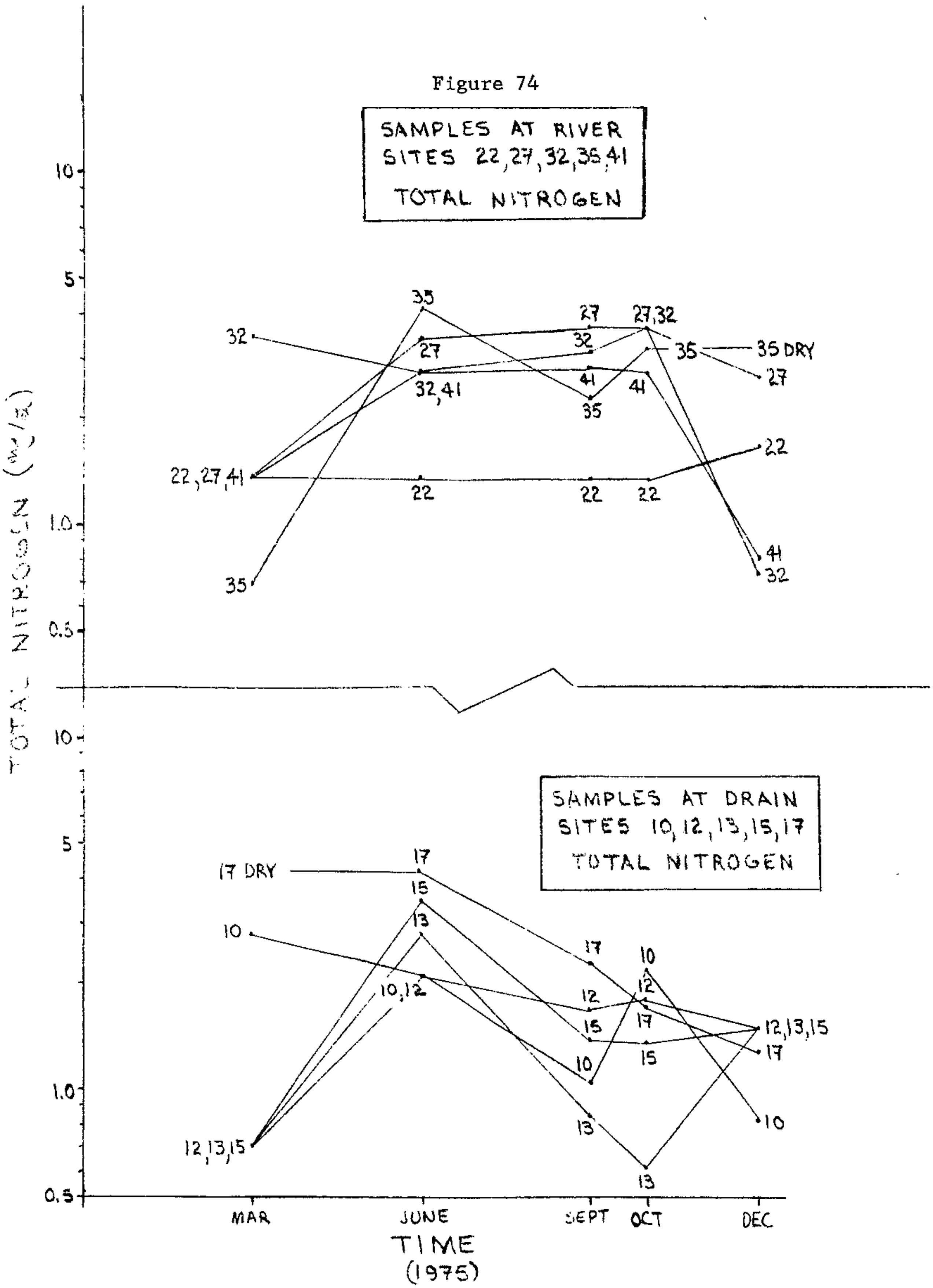
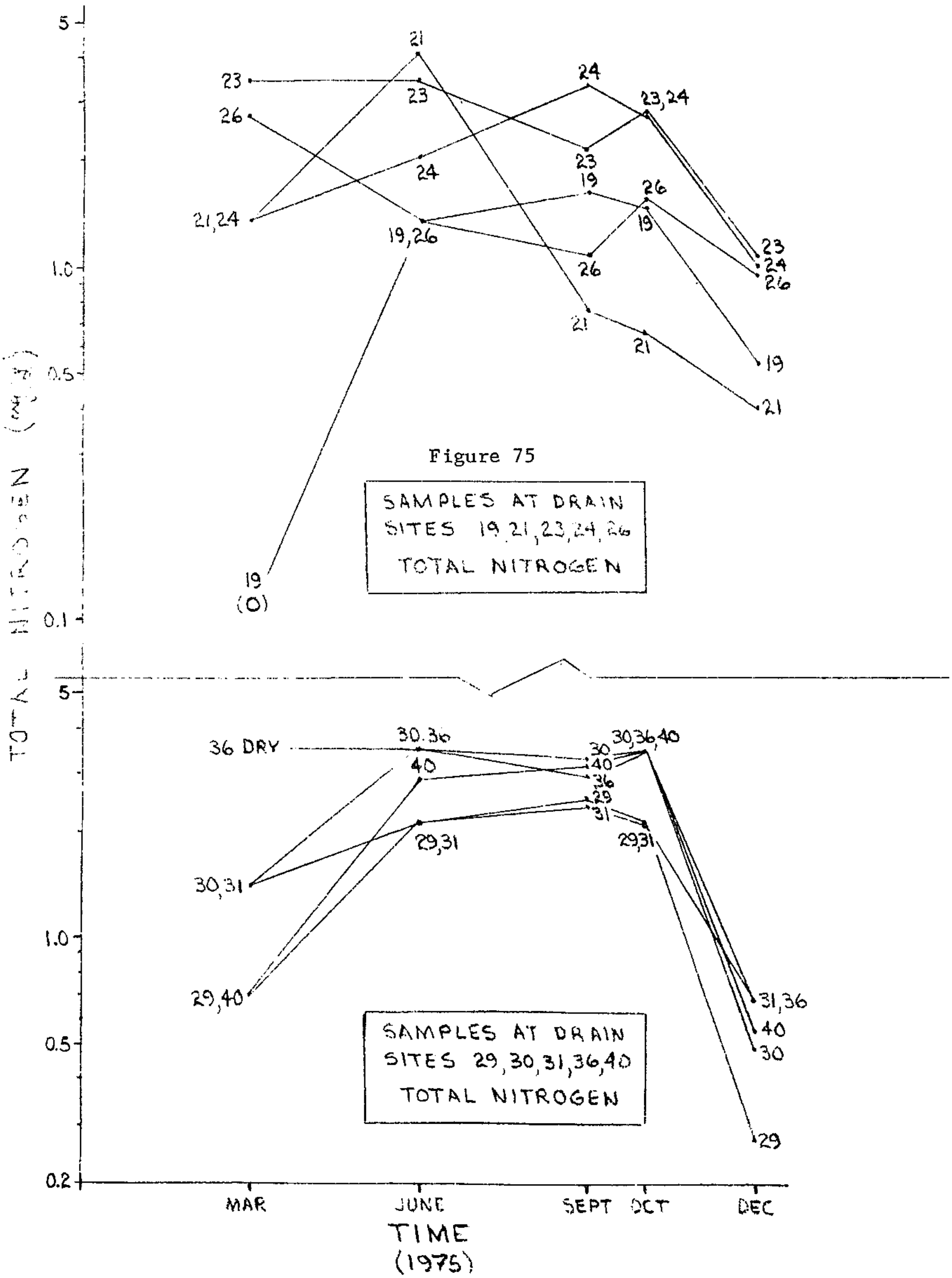

SAMPLES AT RIVER SITES 1,2,3,4,7 TOTAL NITROGEN
SAMPLES AT RIVER SITES 8,9,14,16,18 TOTAL NITROGEN
TOTAL NITROGEN (mg/l)
10
5
1.0
0.5
0.1
DRY
MAR
JUNE
SEPT
OCT
DEC
TIME
(1975)

Figure 74

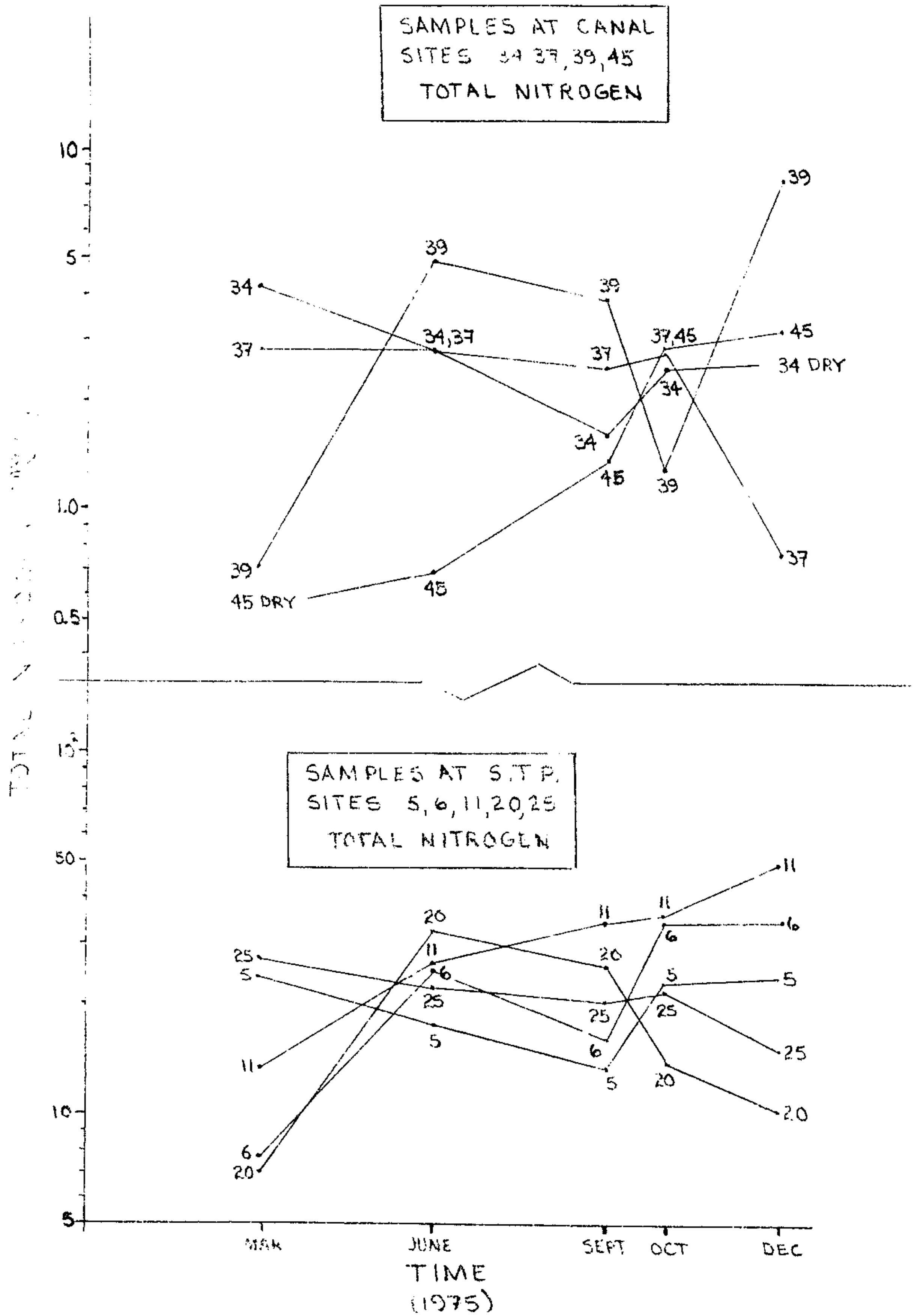

SAMPLES AT RIVER SITES 22, 27, 32, 35, 41 TOTAL NITROGEN
SAMPLES AT DRAIN SITES 10, 12, 13, 15, 17 TOTAL NITROGEN
TOTAL NITROGEN (mg/l)
10
5
1.0
0.5
32
35
27
32,41
41
22
22,27,41
27,32
35 DRY
17 DRY
17
15
13
10
10,12
12
12,13,15
MAR
JUNE
SEPT
OCT
DEC
TIME
(1975)



SAMPLES AT DRAIN SITES 19,21,23,24,26 TOTAL NITROGEN
SAMPLES AT DRAIN SITES 29,30,31,36,40 TOTAL NITROGEN
TOTAL NITROGEN
TIME (1975)
MAR
JUNE
SEPT
OCT
DEC
36 DRY
19 (0)

Figure 75

Figure 76


SAMPLES AT CANAL SITES 34 37, 39, 45 TOTAL NITROGEN
SAMPLES AT S.T.P. SITES 5, 6, 11, 20, 25 TOTAL NITROGEN
34 DRY
45 DRY
MAR
JUNE
SEPT
OCT
DEC
TIME (1975)

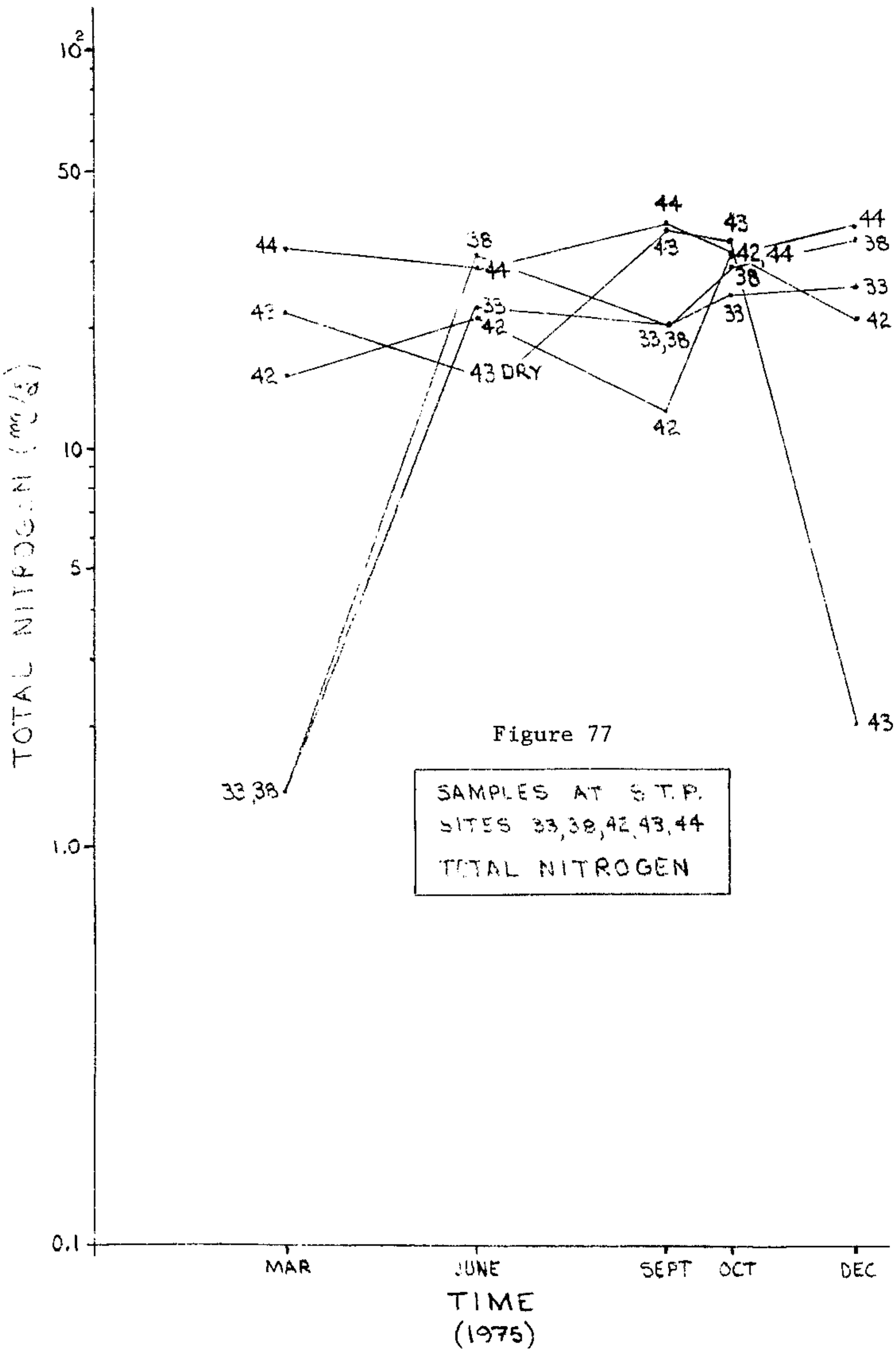
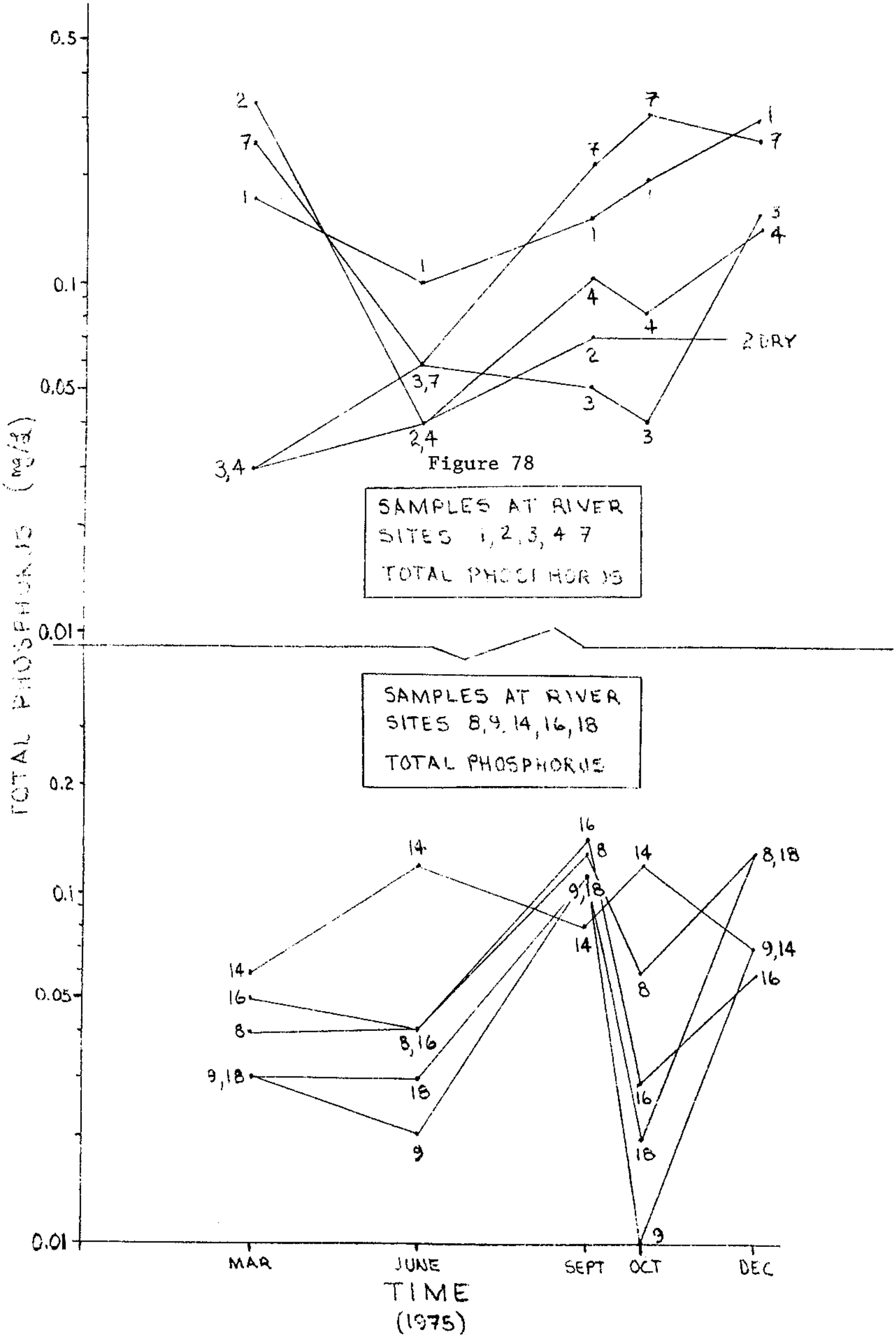


Figure 77

SAMPLES AT S.T.P.
SITES 33,38,42,43,44
TOTAL NITROGEN



SAMPLES AT RIVER
SITES 1, 2, 3, 4 7
TOTAL PHOSPHORUS
2 DRY
SAMPLES AT RIVER
SITES 8, 9, 14, 16, 18
TOTAL PHOSPHORUS
TOTAL PHOSPHORUS (mg/l)
0.5
0.1
0.05
0.01
0.2
MAR
JUNE
SEPT
OCT
DEC
TIME
(1975)

Figure 78

Figure 79

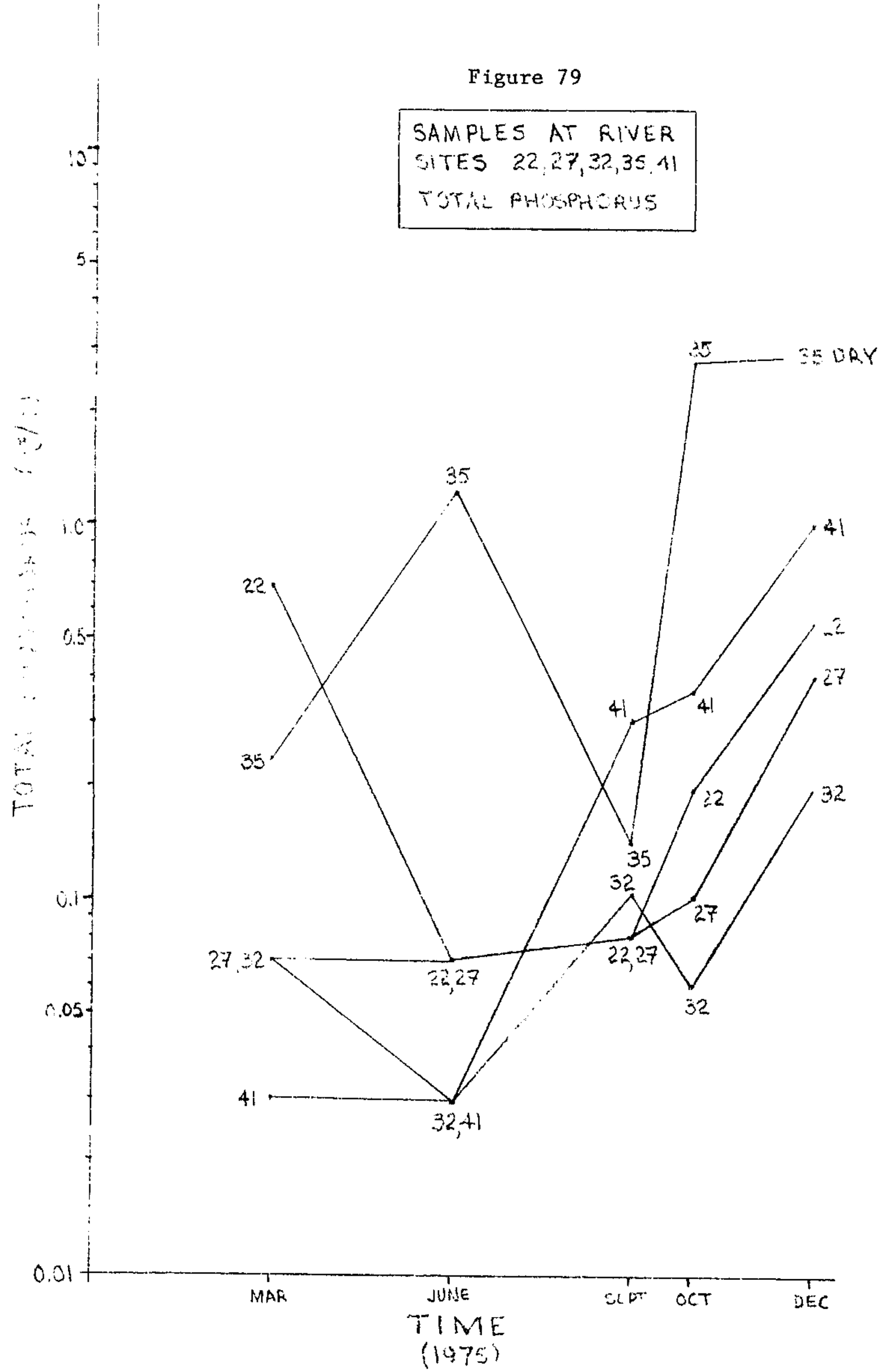

SAMPLES AT RIVER
SITES 22,27,32,35,41
TOTAL PHOSPHORUS
10
5
1.0
0.5
0.1
0.05
0.01
MAR
JUNE
OCT
DEC
TIME
(1975)
22
35
27,32
41
22,27
32,41
35 DRY
41
32
27
22

Figure 80

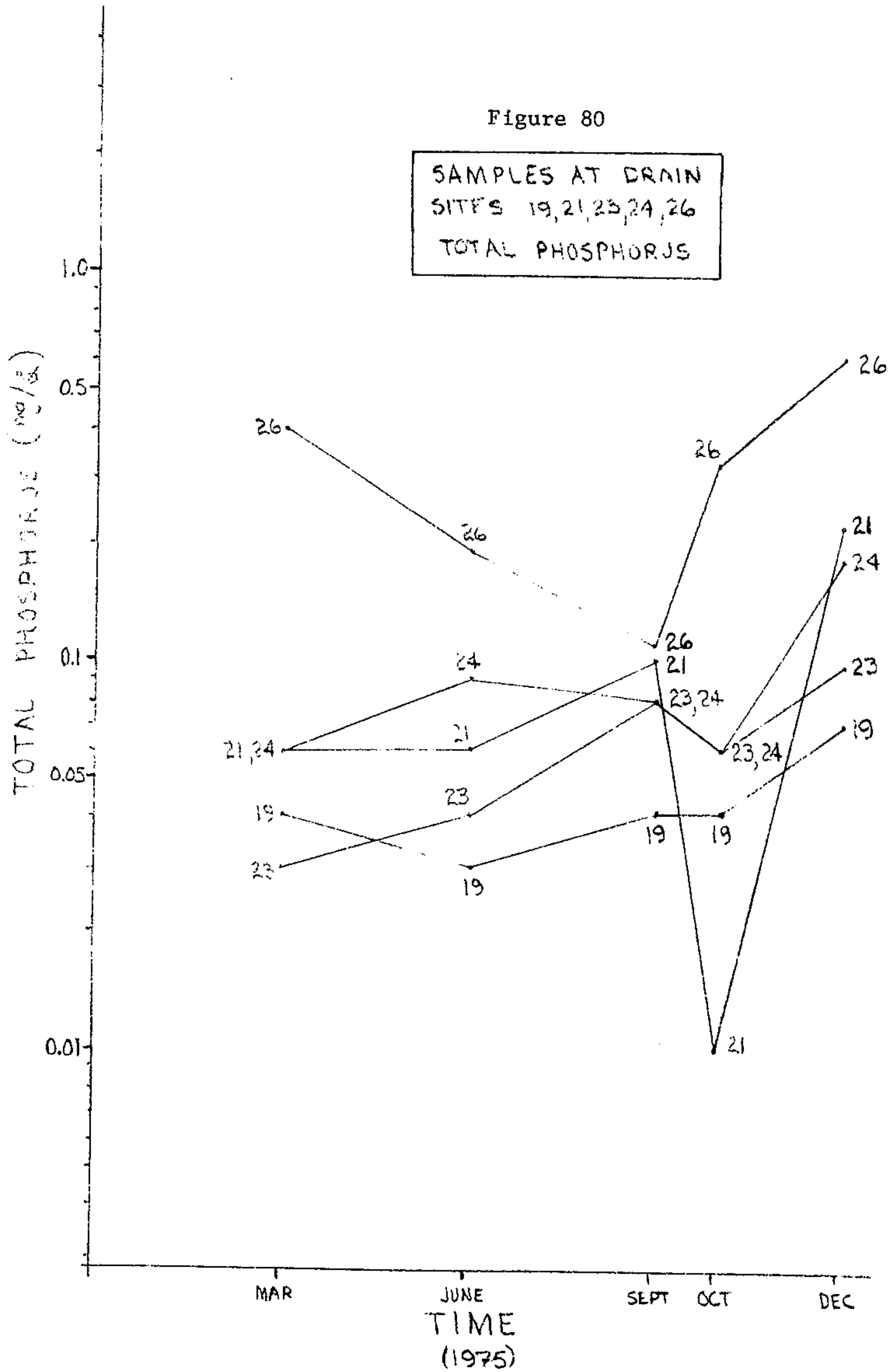

SAMPLES AT DRAIN
SITES 19,21,23,24,26
TOTAL PHOSPHORUS
TOTAL PHOSPHORUS (mg/l)
1.0
0.5
0.1
0.05
0.01
MAR
JUNE
SEPT
OCT
DEC
TIME
(1975)

Figure 81

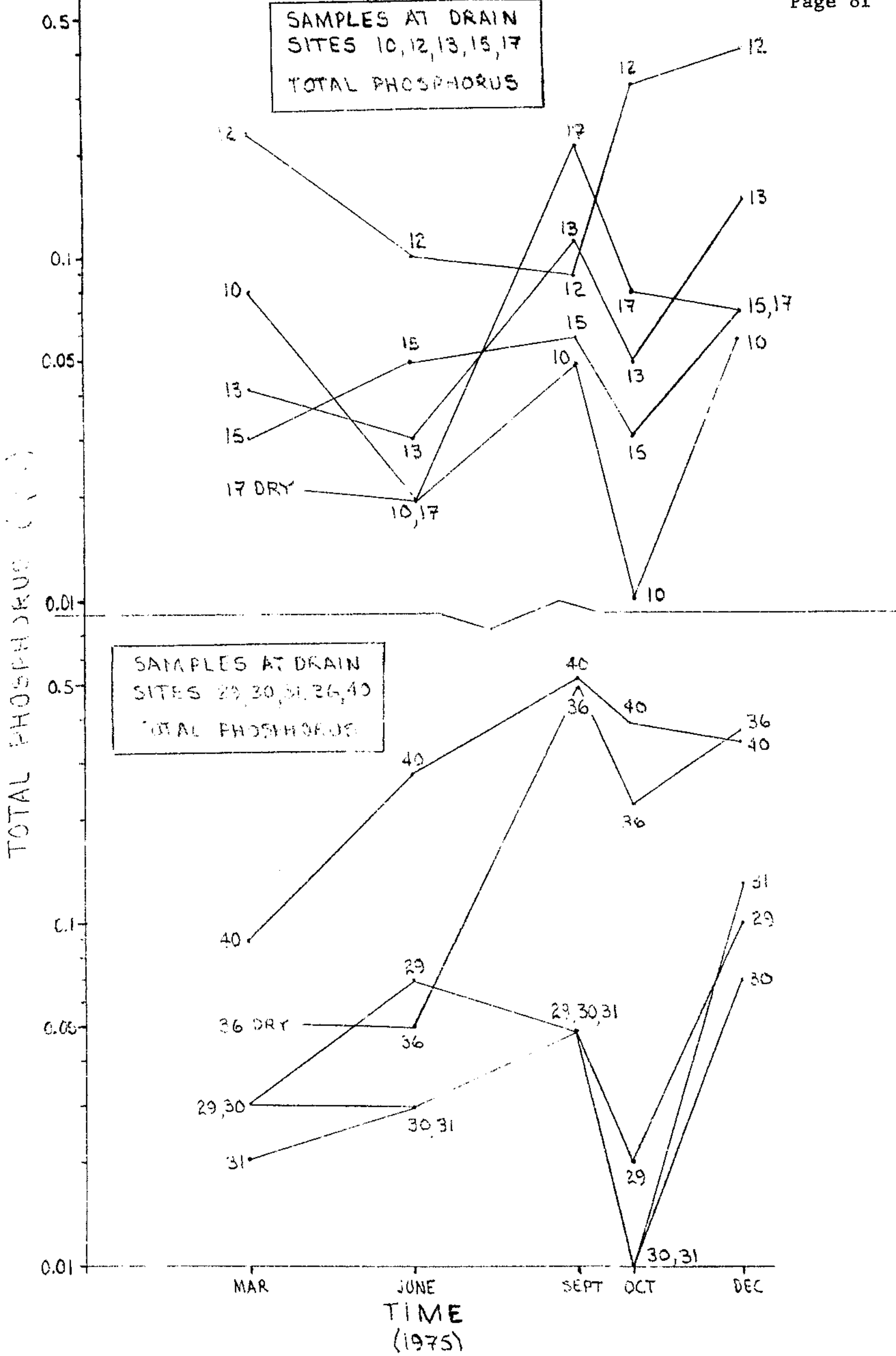

SAMPLES AT DRAIN SITES 10, 12, 13, 15, 17 TOTAL PHOSPHORUS
SAMPLES AT DRAIN SITES 29, 30, 31, 36, 40 TOTAL PHOSPHORUS
TOTAL PHOSPHORUS
0.5
0.1
0.05
0.01
17 DRY
36 DRY
MAR
JUNE
SEPT
OCT
DEC
TIME
(1975)

Figure 82

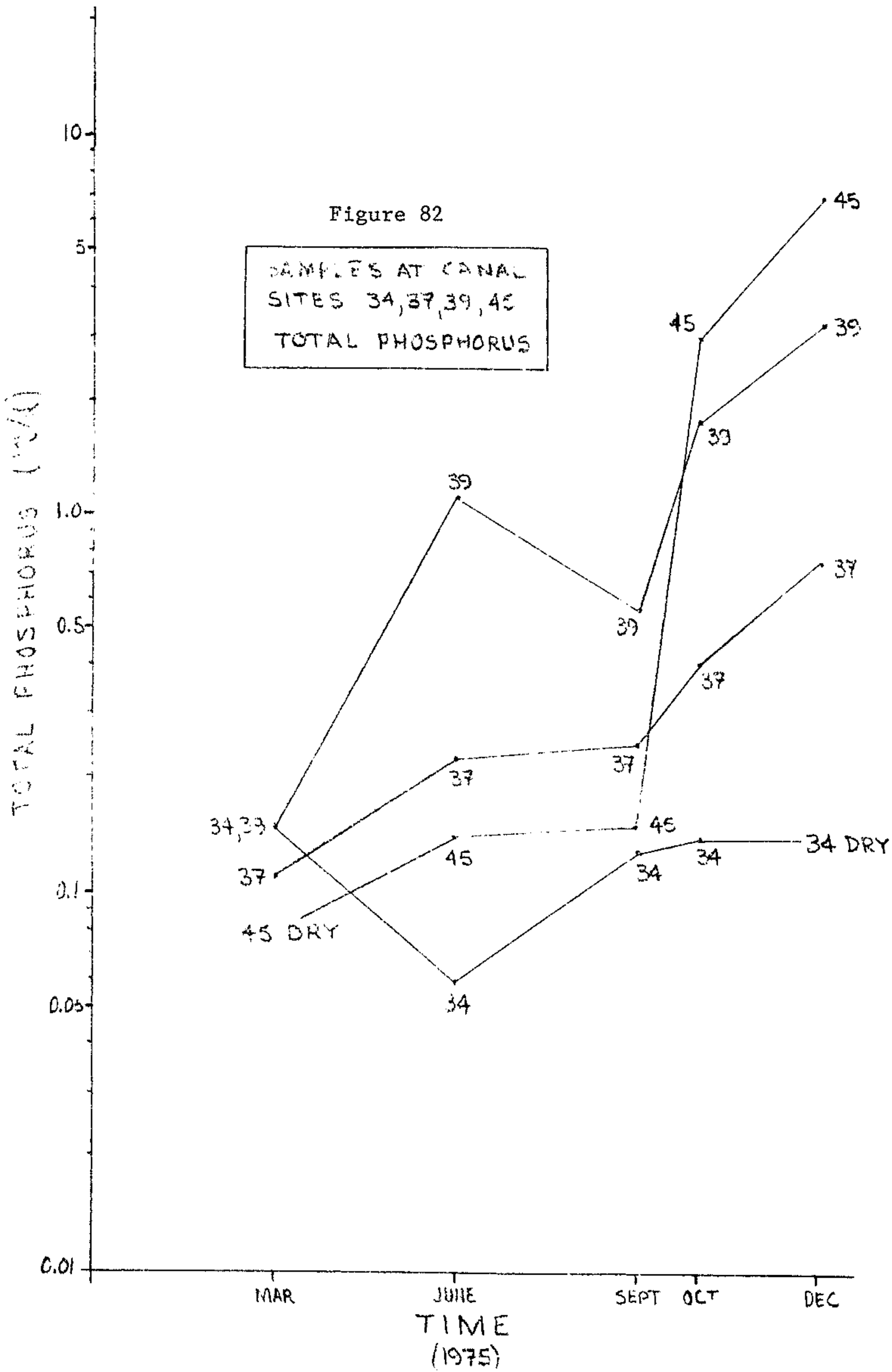

SAMPLES AT CANAL
SITES 34, 37, 39, 45
TOTAL PHOSPHORUS
TOTAL PHOSPHORUS
10
5
1.0
0.5
0.1
0.05
0.01
45
39
39
39
39
37
37
37
37
34,39
37
45
45
45
34
34
34
34 DRY
45 DRY
MAR
JUNE
SEPT
OCT
DEC
TIME
(1975)

Figure 83

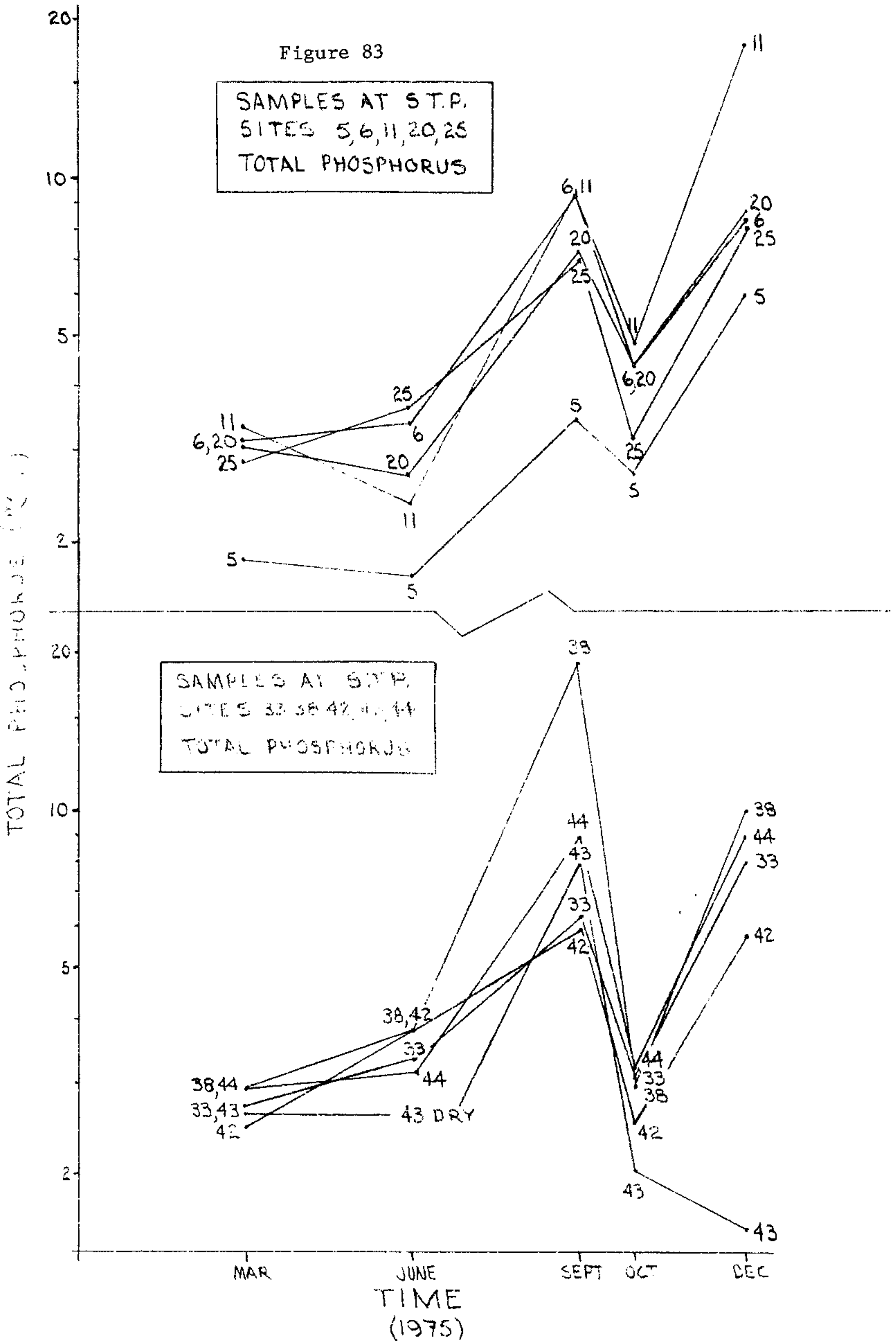

SAMPLES AT S.T.P.
SITES 5,6,11,20,25
TOTAL PHOSPHORUS
SAMPLES AT S.T.P.
SITES 33,38,42,43,44
TOTAL PHOSPHORUS
TOTAL PHOSPHORUS
20
10
5
2
43 DRY
MAR
JUNE
SEPT
OCT
DEC
TIME
(1975)

Figure 84

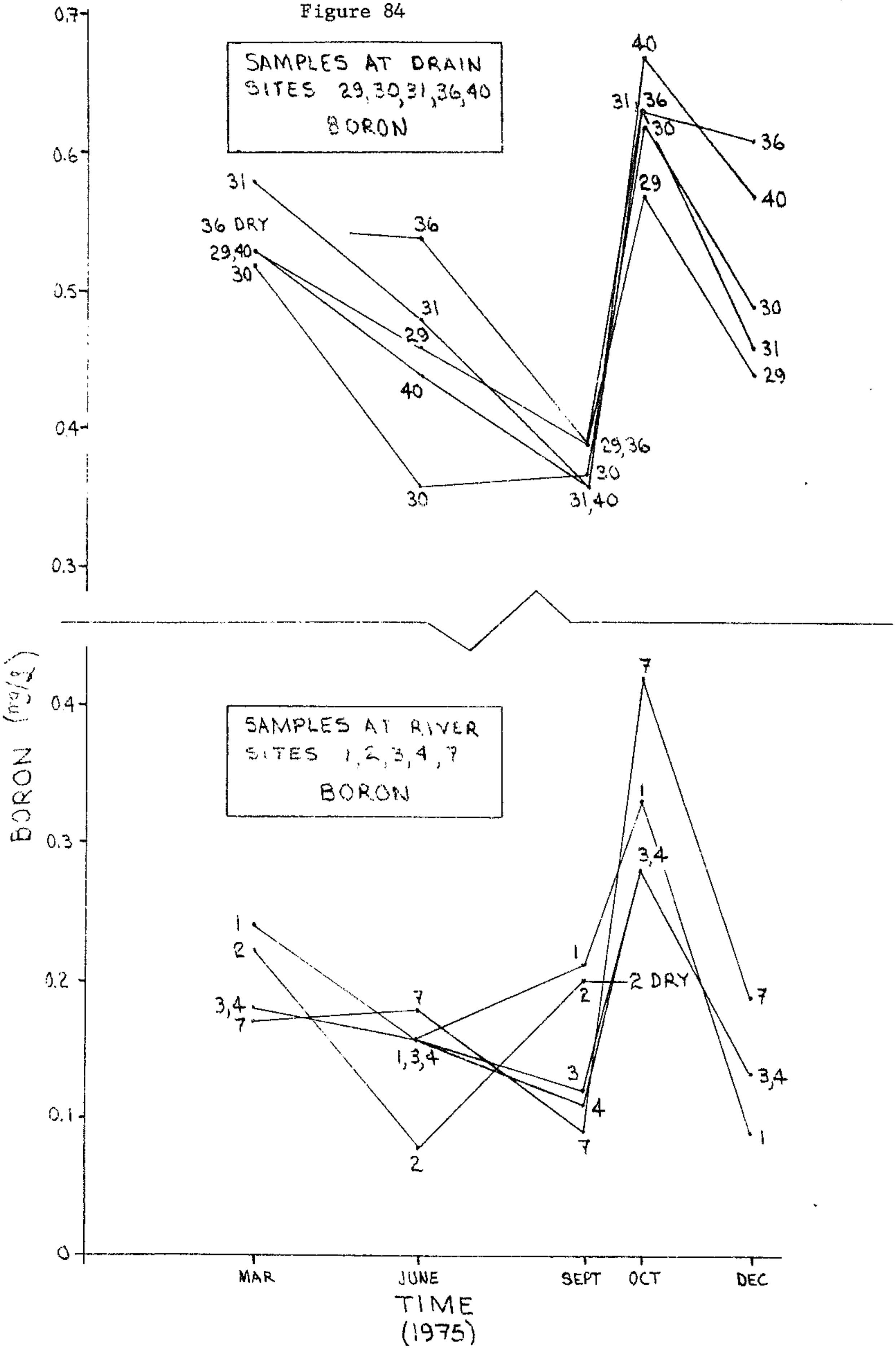
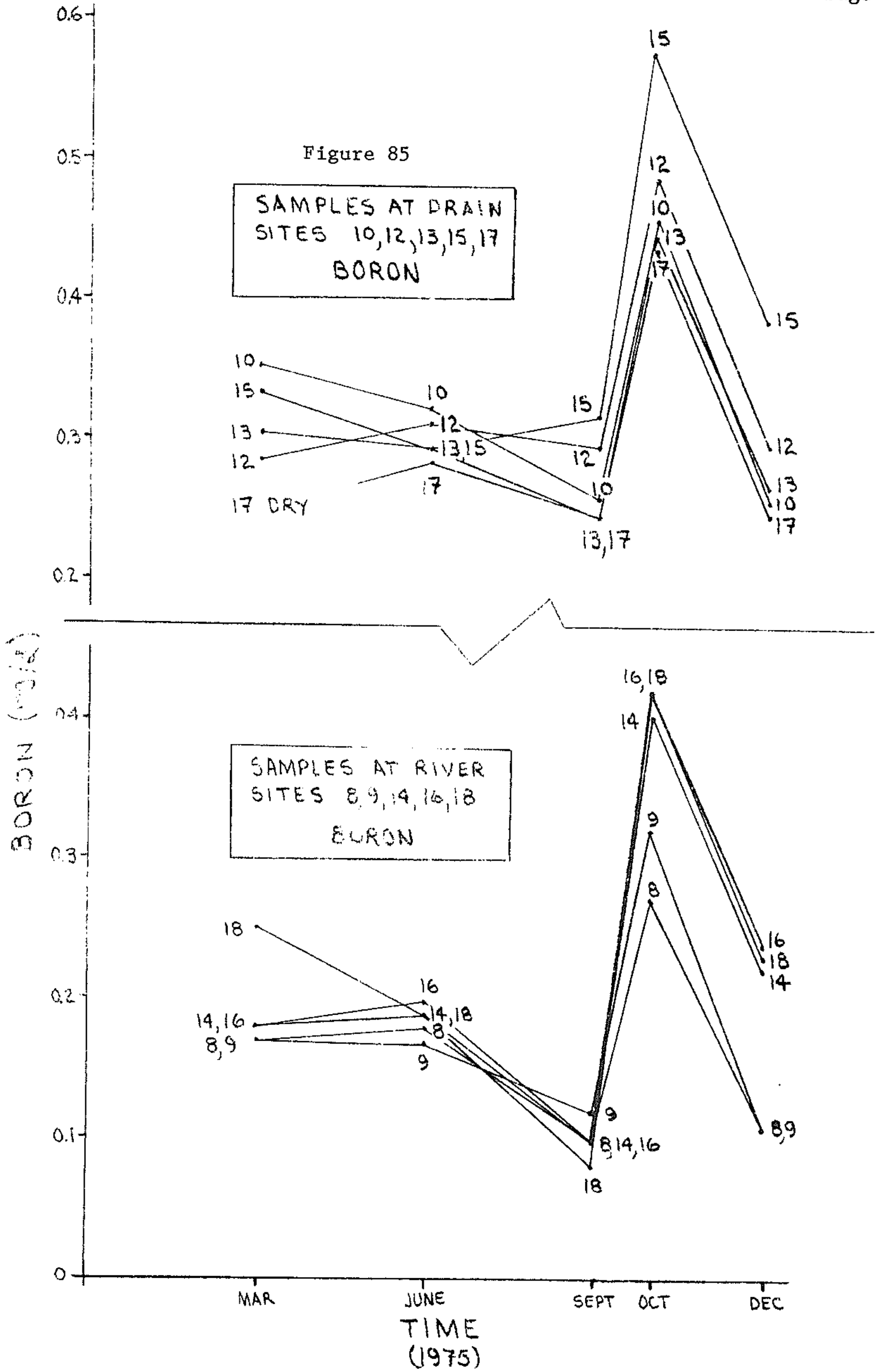

SAMPLES AT DRAIN SITES 29,30,31,36,40 BORON
SAMPLES AT RIVER SITES 1,2,3,4,7 BORON
BORON (mg/l)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
36 DRY
2 DRY
MAR
JUNE
SEPT
OCT
DEC
TIME
(1975)

Figure 85


SAMPLES AT DRAIN
SITES 10,12,13,15,17
BORON
SAMPLES AT RIVER
SITES 8,9,14,16,18
BORON
17 DRY
BORON (mg/l)
0.6
0.5
0.4
0.3
0.2
0.1
0
MAR
JUNE
SEPT
OCT
DEC
TIME
(1975)

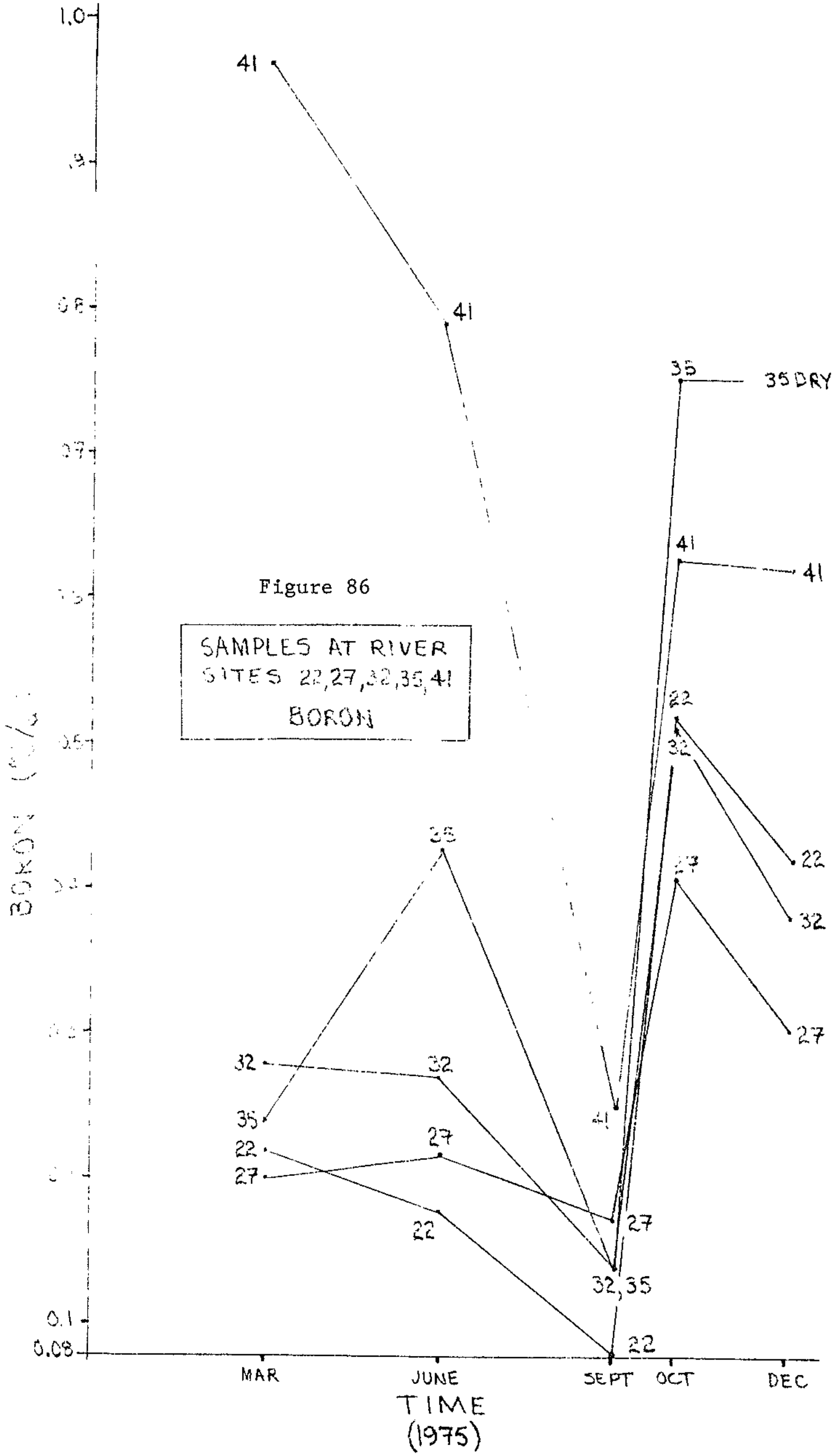

SAMPLES AT RIVER
SITES 22,27,32,35,41
BORON
35 DRY
TIME
(1975)
MAR
JUNE
SEPT
OCT
DEC
1.0
0.1
0.08

Figure 86

Figure 87

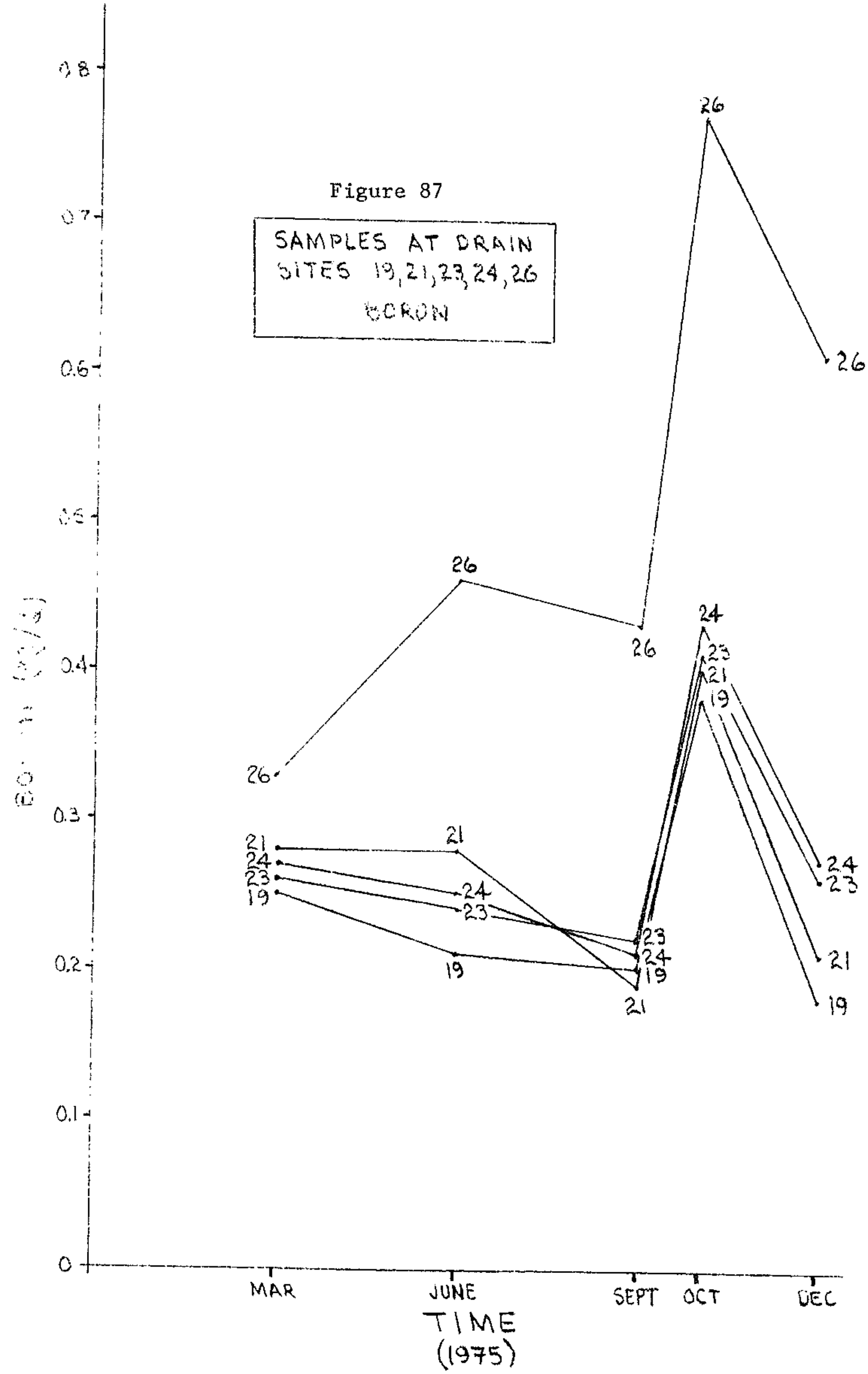
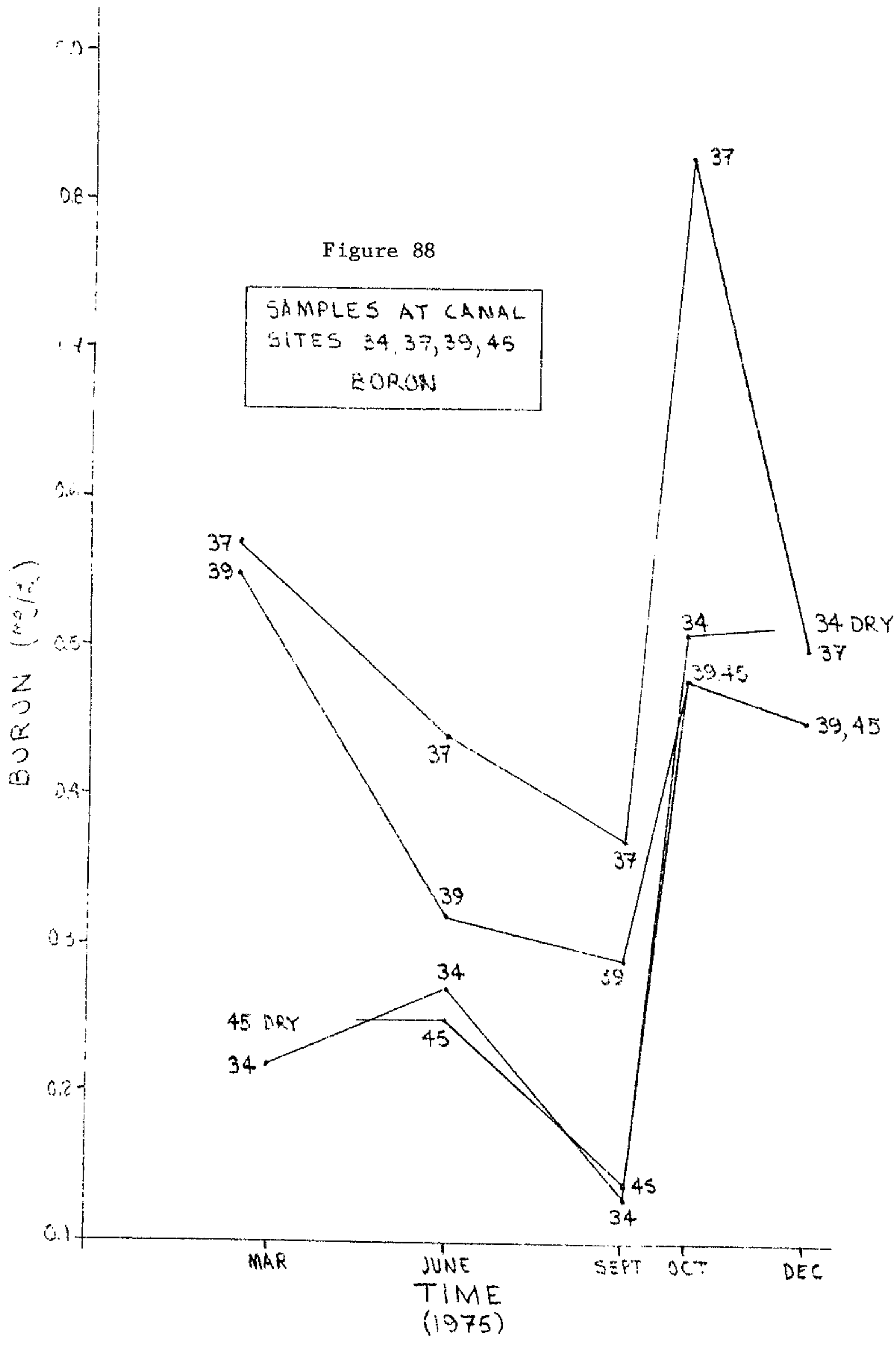

SAMPLES AT DRAIN
SITES 19, 21, 23, 24, 26
BORON
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
MAR
JUNE
SEPT
OCT
DEC
TIME
(1975)

Figure 88


SAMPLES AT CANAL SITES 34, 37, 39, 45
BORON
BORON
0.8
0.5
0.4
0.2
0.1
37
39
34
45 DRY
45
34 DRY
39,45
MAR
JUNE
SEPT
OCT
DEC
TIME
(1975)

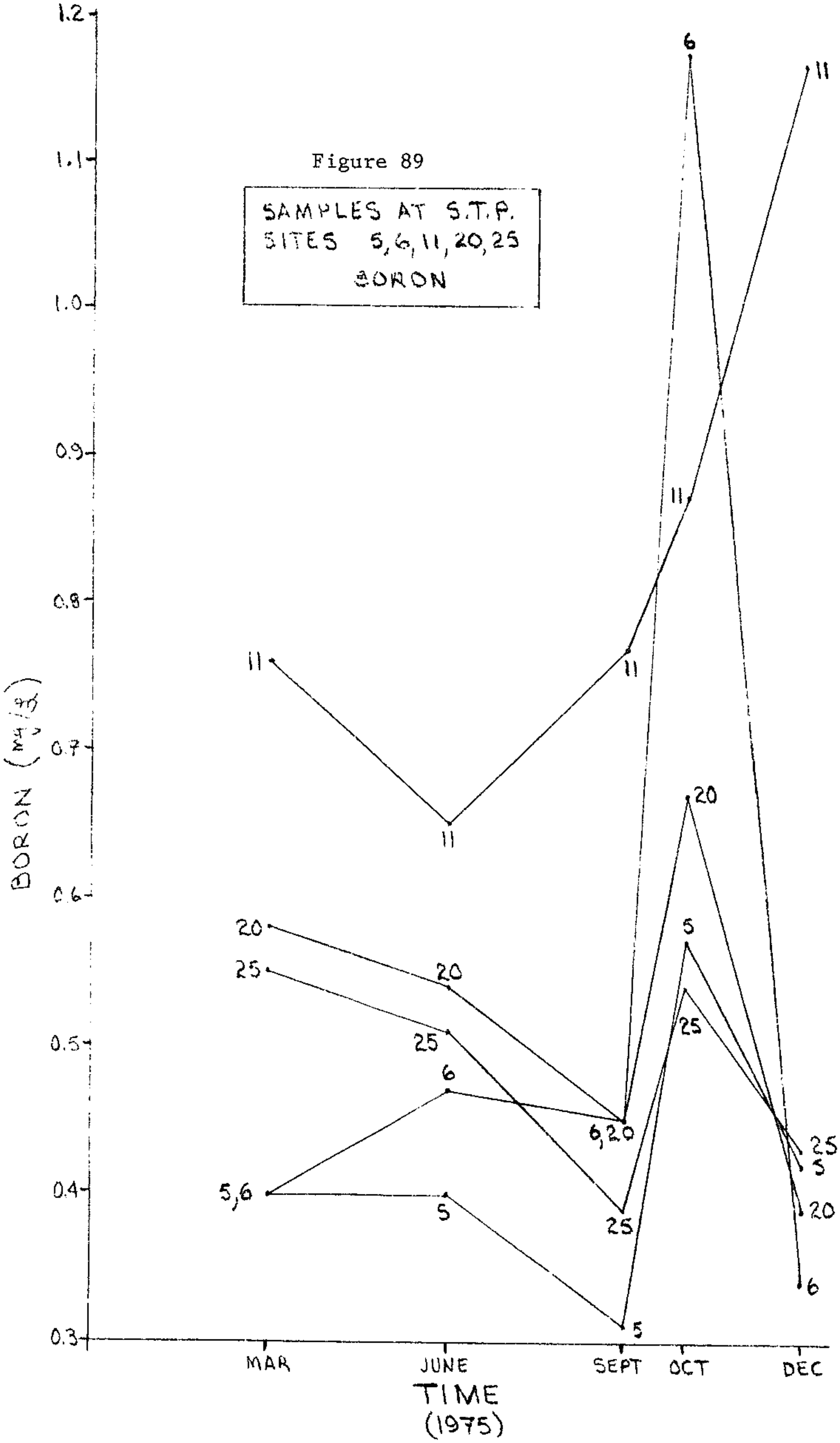
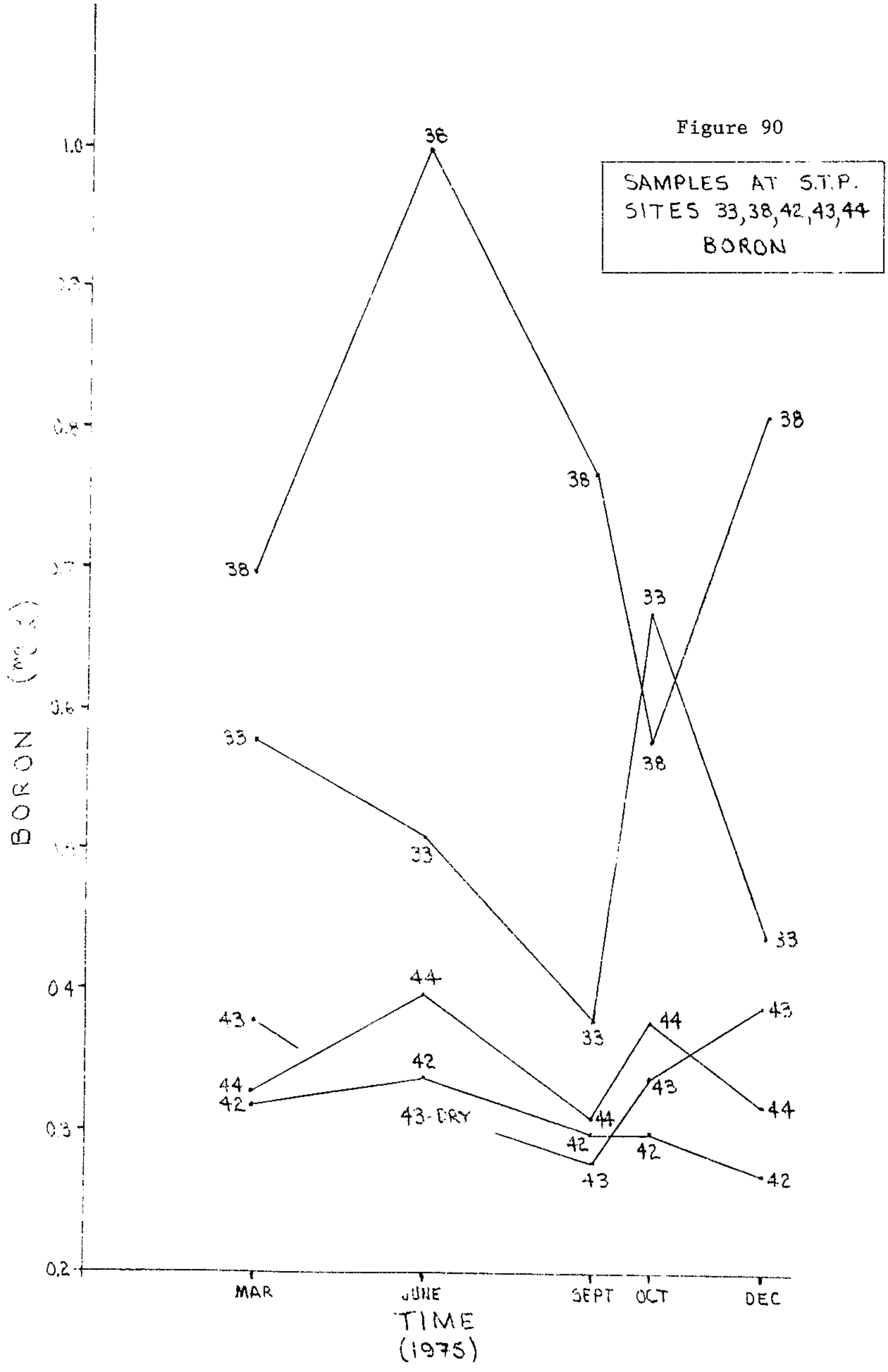


Figure 89
SAMPLES AT S.T.P.
SITES 5,6,11,20,25
BORON
BORON (mg/l)
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
11
6
20
25
5,6
5
6,20
MAR
JUNE
SEPT
OCT
DEC
TIME
(1975)

Figure 90


SAMPLES AT S.T.P.
SITES 33,38,42,43,44
BORON
BORON
TIME
(1975)
MAR
JUNE
SEPT
OCT
DEC
1.0
0.8
0.6
0.4
0.3
0.2
43-DRY

RIO GRANDE WATER QUALITY BASE LINE STUDY
RESULTS OF TRANSPARENCY, TURBIDITY, AND THE
TOTAL SUSPENDED SOLIDS ANALYSIS ON SAMPLES
COLLECTED IN VARIOUS IRRIGATION CANALS
ON THE RIO GRANDE PROJECT
JULY AND AUGUST, 1975
APPENDIX D

APPENDIX D

RIO GRANDE WATER QUALITY BASE LINE STUDY

Results of Transparency, Turbidity, and the

Total Suspended Solids Analysis on Samples

Collected in Various Irrigation Canals

on the Rio Grande Project

July and August, 1975

INTRODUCTION

As part of the Rio Grande Water Quality Base-Line Study being conducted at New Mexico State University, field and laboratory assistance was provided the U. S. Bureau of Reclamation in an evaluation of canal water transparencies versus the suspended solids being transported by the flow. Samples were collected on six days during July and August from canals on the Rio Grande Project; turbidity and total solids determinations were made on these samples. Field transparencies were evaluated.

STUDY OBJECTIVES AND PROCEDURES

Due to the high turbidity levels of irrigation distribution waters, the Rio Grande Project is not plagued with aquatic weed problems. In the case of aquatic weeds, the high levels of suspended solids is an asset to the project, but on the other hand the deposition of these solids eventually restrict the water carrying capacity of canals and laterals. The purpose of this brief study was to obtain a few sample quantitative figures for light penetration with respect to transported solids. The parameters evaluated were (a) turbidity, (b) total suspended solids, and (c) transparency. An estimate of the fraction of the susupended solids that were organic matter was determined by ignition of the dry solids to obtain a measure of the residual nonorganic ash.

Samples were collected at three depths in each canal:

(a) just below level of limnetic zone;

(b) half the distance to the bottom from the surface; and

(c) just off bottom (one foot from bottom).

Samples were collected from three (3) sites on each of the major canals and from two sites on each of the laterals. These sample sites were located near the following points:

(A) On canals

(a) one mile from a diversion dam;

(b) 1/3 length of canal; and

(c) 2/3 length of canal;

(B) On laterals

(a) 1/3 length of lateral; and

(b) 2/3 length of lateral.

ANALYTICAL METHODS

(A) Turbidity

The turbidities of the samples were determined in the laboratory using a standard Jackson Turbidimeter, following the procedures set forth in Standard Methods for the Examination of Water and Wastewater, 13th edition. The results are recorded in Jackson Turbidity Units (J.T.U.) with expected precision as shown for different turbidity ranges:

TURBIDITY RANGE J.T.U.	RECORD TO NEAREST
10 - 100	± 5
100 - 400	± 10
400 - 700	± 50
700 or more	±100

(B) Total Suspended Solids and Volatile Solids

The total suspended solids and volatile suspended solids were determined following the proceudres set forth in Standard Methods with the following exceptions:

1) all weighings were made with the filter in the holding pan to eliminate variations due to fragments of the filter sticking to the pan when the filter was removed for weighing. The pans and filters were handled using forceps and were carried in covered boxes to keep contamination by foreign substances to a minimum.

2) Many of the filters remained in the 103°C oven for longer than the specified one hour to insure complete evaporation of the moisture.

The precision of the determination varies directly with the concentration of suspended matter in the sample. According to Standard Methods, the deviations for different concentrations are:

CONCENTRATION (mg/1)	STANDARD DEVIATION
15 mg/1	5.2 mg/1 (33%)
242 mg/1	24 mg/1 (10%)
1,707 mg/1	13 mg/1 (7.6%)

(c) Sampling

The samples were taken as close to the specified sampling depths as possible. Any variations are noted in the data.

In most cases the samples were taken from the center of a bridge or walkway on the upstream side of the bridge.

(d) Transparency

The transparancy readings were taken using a homemade Secchi disc consisting of a car fan blade with a meter stick attached to the rod, welded

Date	Sample	Depth	TRANSPARENCY (cm)	TURBIDITY (J.T.U.'s)	TOTAL SUSPENDED SOLIDS (mg/1)	TOTAL VOLATILE SOLIDS (ORGANIC) (mg/1)
July 31, 1975	#1 WEST SIDE CANAL - 1 MILE BELOW MESILLA DAM	TOP	7 cm	1300	1310	188
		MIDDLE		1300	1282	288
		BOTTOM		1300	1330	140
	#2 WEST SIDE CANAL - 1/3 OF ITS LENGTH 1/4 mile below Rodriguez Drain	TOP	6.5 cm	1300	1382	124
		MIDDLE		1400	1414	126
		BOTTOM		1400	1494	152
	#3 WEST SIDE CANAL - 2/3 OF ITS LENGTH 1/2 mile below Schafer lateral	TOP	4.5 cm	1600	2167	195
		MIDDLE		1700	2274	172
		BOTTOM		1700	2334	144
August 4, 1975	#4 UPPER CHAMBERINO LATERAL 1/3 of its length from head	TOP	9 cm	200	519	32
		MIDDLE		210	405	31
		BOTTOM		200	739	66
	#5 UPPER CHAMBERINO LATERAL 2/3 of its length	TOP	11 cm	260	344	36
		MIDDLE		230	312	40
		BOTTOM		260	378	53
	#6 LA UNION WEST LATERAL 1/3 of its length	TOP	9.5 cm	240	443	35
		MIDDLE		230	548	35
		BOTTOM		240	499	60.7
	#7 LA UNION WEST LATERAL 2/3 of its length	TOP	9.5 cm	290	615	56
		MIDDLE		290	580	62
		BOTTOM		300	688	64

NOTE: Samples #1,2,3, were taken crudely before a sampling device was constructed. However, the veolcity was very high and the sediment load was heavy and the results were probably not greatly affected.

Date		TRANSPARENCY (cm)	TURBIDITY (J.T.U.'s)	TOTAL SUSPENDED SOLIDS (mg/1)	TOTAL VOLATILE SOLIDS (ORGANIC) (mg/1)
August 7, 1975	**#8 LEASBURG CANAL - 1 MILE BELOW LEASBURG DAM**				
	TOP	28 cm	65	80	9
	MIDDLE		65	81	16
	BOTTOM		65	138	14
	#9 LEASBURG CANAL - 1/3 of its length				
	TOP	28 cm	65	61	11
	MIDDLE		65	74	20
	BOTTOM		65	104	25
	#10 LEASBURG CANAL - 2/3 of its length				
	TOP	32 cm	60	84	22
	MIDDLE		60	72	10
	BOTTOM		65	87	18
August 8, 1975	**#11 AMERICAN BEND LATERAL - 1/3 of its length**				
	TOP	35 cm	55	39	12
	MIDDLE		55	43	13
	BOTTOM		55	41	3
	#12 AMERICAN BEND LATERAL - 2/3 of its length				
	TOP	63 cm	*<25	16	9
	MIDDLE		<25	13	4
	BOTTOM		<25	15	4
	#13 TAYLOR LATERAL - 1/3 of its length				
	TOP	30 cm	65	94	11
	MIDDLE		65	87	12
	BOTTOM		65	119	22
	#14 TAYLOR LATERAL - 2/3 of its length				
	TOP	32 cm	60	34	11
	MIDDLE		sample omitted - water too shallow		
	BOTTOM		55	34	11

NOTE: * Turbidity was less than 25 J.T.U. and could not be measured on Jackson Turbidometer.

ALSO: Velocity at this point was almost 0

Date		TRANSPARENCY (cm)	TURBIDITY (J.T.U.'s)	TOTAL SUSPENDED SOLIDS (mg/1)	TOTAL VOLATILE SOLIDS (ORGANIC) (mg/1)
August 12, 1975	#15 EASTSIDE CANAL - 1 MILE BELOW MESILLA DAM				
	TOP	25 cm	110	181	20
	MIDDLE		110	182	23
	BOTTOM		110	205	27
August 12, 1975	#16 EASTSIDE CANAL - 1/3 of its length				
	TOP	25 cm	120	232	28
	MIDDLE		130	244	25
	BOTTOM		120	288	24
August 12, 1975	#17 EASTSIDE CANAL - 2/3 of its length				
	TOP	29 cm	130	247	27
	MIDDLE		140	276	33
	BOTTOM		130	287	28
August 13, 1975	#18 LAKE LATERAL - 1/3 of its length				
	TOP	25 cm	120	102	17
	MIDDLE		130	96	17
	BOTTOM		130	102	16
August 13, 1975	#19 LAKE LATERAL - 2/3 of its length				
	TOP	23 cm	Only one sample taken due to shallowness of water		
	MIDDLE		110		
	BOTTOM			58	16
August 13, 1975	#20 THREE SAINTS LATERAL - 1/3 of its length				
	TOP	13 cm	210	231	21
	MIDDLE		210	273	28
	BOTTOM		220	296	30
August 13, 1975	#21 THREE SAINTS LATERAL - 2/3 of its length				
	TOP		210	265	22
	MIDDLE		210	267	26
	BOTTOM		200	294	26